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CONTENTS.

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Original Communications.

MALARIA IN INDIA: THE SYNTHETIC DRUGS AND THE RELAPSE RATE.

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AND

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(From the Section of Hygiene and Pathology, Medical Directorate, Army Headquarters, India.)

CONTENTS.

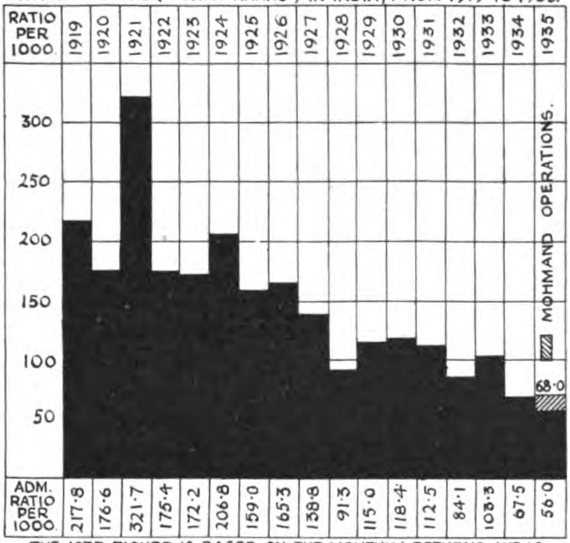
INTRODUCTORY REMARKS.

This paper deals solely with the malaria statistics of the British troops in India. The average annual strength of these troops is maintained at about 55,000; and the actual number of admissions to hospital for malaria has varied between 18,878 in 1921, and 3,676 in 1934.

This special section of the military population has been singled out because it best lends itself to strict and continuous control, and to statistical accuracy. Its mode of living, working, hospitalization and so forth, are little liable to the influence of factors which lead to fallacies and vitiate conclusions.

GRAPH I

A GRAPH SHOWING THE ANNUAL INCIDENCE OF MALARIA (NUMBER OF ADMISSIONS PER 1000 OF STRENGTH) AMONGST BRITISH TROOPS ("OTHER RANKS") IN INDIA, FROM 1919 TO 1935.



THE 1935 FIGURE IS BASED ON THE MONTHLY RETURNS AND IS LIABLE TO BE SLIGHTLY ALTERED BY THE ANNUAL COMPILATION

Graph I shows the total number of admissions to hospital for malaria, per 1,000 of strength. Inasmuch as the figures are swollen by admissions for relapses, it is not a picture of the admission ratio of infections alone: hence the marked and fairly steady decline may be ascribed to one or both of the following causes :—

(*a*) Decrease in the number of infections (primary and re-infections).

(*b*) Decrease in the number of relapses.

The object of this paper is not to prove that the incidence of fresh malaria amongst British troops in India has declined—although we have good reasons for the belief that, in all probability, such a decline is in progress. As its title indicates, the object of the paper is to show that, in recent years, a great decrease of relapsing malaria has occurred: that, in view of the progressive improvement culminating in the 1934-35 figures,

this decrease is likely to be permanent, and likely to be still more marked—up to a point—in the future; and that, for this welcome event, the greatest share of the credit is due to new methods of treatment.

For purposes of comparison, the relapse rate in the days when quinine alone was used is of importance. We are not in a position to give a strictly accurate figure, but Manifold (1931) puts the relapse rate at 42 per cent., and Dixon (1933) at about 50 per cent. Those who have had experience of malaria in India a decade ago will agree that even the latter figure is not unduly high. Sinton and Bird (1929) treating 667 patients of the type admitted to the Malaria Treatment Centre (i.e. cases which have relapsed repeatedly in the past), computed the average relapse rate to be 68 per cent.

DECREASE IN THE NUMBER OF INFECTIONS.

A decrease in the number of infections may be brought about by several factors of different sorts. Of these, the dominant one is weather.

Weather produces a direct effect on malarial incidence for the year, and may produce an indirect effect—on account of aftermath or "carry over"—on the incidence for the succeeding year.

This carry over is, of course, composed almost entirely of relapses.

In 1934, meteorological conditions were not good. For purposes of comparison, their adverse influence on malarial incidence in this year may be evaluated by allotting the empirical figure, 10.[1]

On this arbitrary basis, the corresponding figures for some of the years preceding 1934 may be set down thus:—

1924	..	15	
1928	..	0	(drought)
1929	..	17	
1930	..	5	(about normal)
1931	..	5	,, ,,
1932	..	8	
1933	..	20	
1934	..	10	

Variations in these conditions are reflected in the incidence for 1924 and 1928; but corresponding *pro rata* variations are not registered in other years, notably in 1933.

If the incidence figures on the graph be compared with the above index figures for weather, it will be seen that in later years there is little or no relationship between the two. In the year 1928, parallelism between incidence and weather conforms to type; but thereafter it is surprising how little the incidence seems to have been influenced by weather: where a marked rise in incidence might reasonably be expected, actually the rise is slight, or even absent.

[1] This "evaluation figure" method is here employed solely in order to present the subject in as brief and graphic a manner as possible. The figures are based on the reports of the Government of India Meteorological Department; and the effect of weather conditions on malarial incidence in 1932-34 are fully discussed in the War Office Reports on the Health of the Army for these three years.

Taking into account meteorological conditions alone, the incidence of 1929 and 1932 is unduly low, and that of 1933 and 1934 remarkably low.

Next to weather, *war and civil disturbances* exercise a profound effect because, under their baleful influence, the troops are insufficiently protected and—when infected—not always in a position to receive adequate courses of treatment. Delayed attacks and relapses are rife. For these reasons, the 1921 figure of incidence is very high.

In more recent years, war and civil disturbances—separately or together—broke out in 1930-33 : an aftermath from the Mohmand-Bajaur operations was to be expected in 1934 ; and the Mohmand campaign was conducted in the malaria season of 1935.

It therefore follows that a comparison of the 1919-21 incidence with that of the period 1930-35 is of great interest and importance. It is profitable to speculate on the comparatively low admission rates for malaria in these later years, despite the Service conditions attendant on civil disorders and wars.

The incidence of infections is also more or less influenced by various *antimalaria measures*, the chief of which is field work.

There is no doubt that from the end of the Great War until about 1931 the quality of minor field work has steadily improved ; but since the latter date (when various stringent economies made further progress difficult) a comparatively level standard has been maintained.

In 1928 the Ross Field Experimental Station at Karnal, in the Punjab, began to train, annually, a few selected military medical officers in antimalaria field work. By 1931 the beneficial effects of this special training became evident. They also became stabilized, because officers of the Royal Army Medical Corps left the country on expiry of their tours, while those of the Indian Medical Service were claimed by "civil" from time to time. The supply from Karnal was steady; but it was (and is) insufficient adequately to meet the demand.

Thus it cannot be said that, during the past three or four years, the decline in incidence has resulted from improved field measures of a minor type.

The same remarks apply to major engineering antimalaria works because, in the autumn of 1931, a "cut" of 65,000 rupees (nearly £5,000) in the antimalaria grant all but brought this form of activity to an end ; and since then the "cut" has not been restored.

From 1928 to 1931 a certain amount of progress was made with the mosquito-proofing of barracks; but when the economy axe fell it was decided that, in view of financial stringency, no further new works in the direction of the mosquito-proofing of buildings should be undertaken until the situation became more normal.

By 1931, a few of the worst malaria stations had been proofed, with

marked drops in the local incidence of the disease; but the effect of this on general malarial incidence was small; and, since then, this state of affairs has remained unchanged.

In 1925, the measure known as "cold storage"—the move of the bulk of the troops to the hills during the malaria season—was introduced, and there is little doubt that this was to a large extent responsible for the decline in malaria which occurred in the ensuing few years. If it were possible to apply this measure universally, it would of course provide a complete solution to the malaria problem. Unfortunately it presents serious administrative difficulties, tends to interfere with training, and has to take second place to more pressing considerations such as imminent frontier hostilities. In the last few years, for various reasons, fewer troops have enjoyed complete protection under this scheme, so that the fall in admissions seen from 1932 onwards is not to be explained in this way.

It comes to this, then, that while we believe that some decline in the incidence of infections has occurred in recent years, an examination of the factors influencing such a decline clearly indicates that the decrease in the malaria admission rate demands some other, and more convincing, explanation. This decrease is so great and so steady that, in view of what has been said above, it cannot be accounted for by a decline in the incidence of infections alone.

Those who are interested in this subject will find the foregoing introductory remarks substantiated, and elaborated in greater detail, in the War Office Reports on the Health of the Army (Section: India); and in the Annual Reports (Vol. II)[1] of the Public Health Commissioner with the Government of India.

DECREASE IN THE NUMBER OF RELAPSES.

From time to time this question has been the subject of considerable controversy, and is of much interest because of the claim first made by Sinton and Bird (1928), and elaborated by Sinton, Smith and Pottinger (1930), that plasmoquine in combination with quinine exercises a specific action in reducing the relapse rate of benign tertian malaria. This claim has been challenged by the Malaria Commission of the Health Organization of the League of Nations (1933) on theoretical grounds, and also on the strength of certain results obtained (it would appear) in the treatment of artificially induced malaria in patients suffering from general paralysis of the insane.

STAGES IN THE INTRODUCTION OF THE SYNTHETIC DRUGS.

Table I gives in chronological order the various stages which have been gone through in the adoption of these drugs for use in the Army.

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[1] This volume is prepared annually, for publication by the Public Health Commissioner with the Government of India, by the Hygiene and Pathology Section, Medical Directorate, Army Headquarters.

TABLE I.—ADOPTION OF THE SYNTHETIC DRUGS IN THE ARMY IN INDIA, SHOWN IN CHRONOLOGICAL SEQUENCE.

Year	Plasmoquine	Atebrin
1927 onwards	Used experimentally at the Malaria Treatment Centre	
1930-31	Used experimentally in certain selected hospitals	
1931	A limited quantity of plasmoquine purchased and distributed for general use	Used experimentally at the Malaria Treatment Centre
1932	Plasmoquine authorised and available on an "as required" scale	Limited quantity purchased for use in selected hospitals
1933-35	Standard courses of treatment laid down for use in all uncomplicated cases	Embodied in standard course of atebrin-plasmoquine treatment

STANDARD COURSES OF TREATMENT.

The standard courses of treatment adopted for general use in 1933 and slightly modified in 1934 are as follows :—

Benign Tertian Malaria.

(1) Atebrin-plasmoquine, consisting of atebrin 0·3 gramme daily, given to alternate cases for five and seven days respectively, and in each case followed by plasmoquine 0·03 gramme daily for five days.

A subsequent instruction—based on certain reports to the effect that atebrin was occasionally slow in controlling the febrile paroxysms—laid down that, if considered necessary, these courses could be preceded by one or two days of quinine treatment.

The year's experience showed a balance of evidence in favour of the seven-day course of atebrin, which consequently was adopted in 1934.

(2) Quinine-plasmoquine, consisting of quinine 20 grains and plasmoquine 0·03 gramme daily for twenty-one days. This course of treatment was originally recommended by Manifold (1931).

In 1934, a shorter course of fourteen days' treatment was tried out in Southern Command and Waziristan District.

Malignant Tertian Malaria.

(1) Atebrin-plasmoquine as above.

(2) Quinine as considered necessary, followed by a course of plasmoquine: a five-day course of 0·03 gramme daily was recommended, to be repeated at a later date if gametocytes were still present.

Quartan Malaria.

Atebrin-plasmoquine as above.

Mixed Infections.

According to the special circumstances of the case.

ANALYSIS OF MALARIA STATISTICS FROM JULY, 1934, TO JUNE, 1935 (INCLUSIVE).

(*a*) *Procedure Adopted.*—The period from July 1 of one year to June 30 of the next has been arbitrarily selected as representing a malaria year. We recognize that this is open to criticism. Undoubtedly primary cases of malaria occur in some parts of India in June, and to a lesser extent in May. On the other hand, it is equally certain that relapses carried over from the previous year are of relatively common occurrence in May and June; and as it is the object of this investigation to determine relapse rates, and in doing so to avoid anything which might produce an unduly favourable result, it is considered that the above period is, in this respect, the fairest.

It was our first intention to compile tables from reports furnished by hospitals, as was done in previous years. Such tables were actually prepared; but, in checking them, it became obvious that it would be impossible, short of conducting a voluminous correspondence on numerous details, to produce figures of unimpeachable accuracy.

The problem was therefore approached in another way, by means of the statistical cards (A.F. I-1220); and in the tables which follow it is possible to claim accuracy—as far as compilation is concerned—approaching as near to 100 per cent. as is humanly possible. A few details of the methods adopted may be of interest, and will serve to substantiate this claim.

Everyone is familiar with the "Admission and Discharge Book" maintained by each hospital, with its all-important serial number for each patient admitted; and with the statistical card (A.F. I-1220) which is prepared for every entry in the Admission and Discharge Book, and which, among other entries, bears the vital serial number. These cards are sent to Army Headquarters, and are used to prepare the tables embodied in the annual report on the health of the Army. From the monthly returns rendered by hospitals (A.F. A-31) a running review of current happenings is maintained, but this can never have the statistical accuracy of returns prepared from case-cards, nor do the two ever exactly tally.

At Army Headquarters one specially trained statistical clerk has, as his principal duty, the checking of the submission of A.F's. I-1220. For every hospital he maintains a check-sheet, on which are printed serial numbers in the different categories (distinguished alphabetically). As each card is received and verified, the serial number is struck off on the check-sheet. In this way missing and duplicate serial numbers (errors difficult to explain, but of common occurrence) are immediately detected, and hospitals are requested to set matters right. At the end of each year hospitals submit a return showing the last serial number used, from which it can be determined with certainty that a card has been received for every admission to hospital.

Up to this point, i.e. as far as obtaining accurate records from hospitals is concerned, there are two possible sources of error capable of affecting the present investigation.

The first is the outpatient treatment of cases of malaria, because outpatients are not, of course, shown as admissions to hospital. As far as British troops are concerned (and this paper relates only to them) we have no hesitation in saying that this practice is virtually non-existent. Nowadays it would no more be attempted by the medical officer than it would be accepted by his patients. Further, treatment along these lines would sooner or later produce chronic relapsing cases whose admission to hospital could not be evaded. The fact that cases of this kind are conspicuous by their absence—which will be made clear in the following tables—is in itself proof that this practice does not exist.

The second source of error is the concealment of malaria under such diagnoses as sandfly fever, dengue, intestinal toxæmia, etc. The arguments given above apply equally to this fallacy. Normally, malaria does not undergo spontaneous cure; and subsequent relapses, which could not be overlooked, would sooner or later make the true diagnosis unmistakable. As a matter of fact, perusal of the cards leaves little doubt that the shoe is on the other foot, and that a considerable number of the illnesses diagnosed "clinical malaria" are attributable to wholly different causes.

To return to the question of statistical methods, the checked cards are "coded" and, for purposes of the annual report, "sorted" in a variety of ways which have no bearing on the present inquiry. Ultimately, however, they are arranged in drawers by regiments, corps, or similar formations. As before, this procedure is carried out by a specially trained clerk, and is to all intents and purposes foolproof.

For the purpose of the present investigation *all* malaria cards appertaining to the selected period were separated from these groups, and arranged, still by regiments or corps, etc., in strict alphabetical order. By this means, all cards relating to the same man were brought together, and were then attached to each other. Up to this stage the sorting and arranging of the cards was carried out, under supervision, by clerks of the statistical section; from here onwards all the work was carried out personally by one of us. Each card was read through and coded to permit of subsequent sorting under the various heads. Each item has been repeatedly checked, and the margin of possible error is believed to be negligible.

As a preliminary step, cards relating to all units which left India in the trooping season 1934-35 were excluded, as the curtailed "follow-up" possible in such cases is not considered adequate. A similar step is not practicable in the case of those men who left India, not in complete units, but in drafts; nor is it possible, without making a heavy imposition on the time and goodwill of other departments, to trace the whereabouts of each individual; but, working on the average turnover, it may be taken that the number leaving India in drafts is approximately 10 per cent. of those remaining. If, therefore, the relapse percentages which are given later be increased by one-tenth, this error will be adequately covered.

In twenty-eight cases the same individual was admitted on two

separate occasions for different types of malaria, i.e. benign tertian on one occasion, and malignant tertian on another. As these admissions occurred at a time when re-infection was possible, they have been treated as separate infections and, for statistical purposes, appear as separate *cases* in the following compilations.

With this exception, the first admissions to hospital for malaria during the selected twelve months have been taken as the starting point of the observations. All subsequent admissions of the same individual are regarded as relapses. It is beyond question that this procedure worsens the true relapse rate, for it is obvious from the form of parasite found (scanty rings or trophozoites, but no gametocytes) that many second attacks were reinfections and not relapses; but, as selection of cases in this way would inevitably introduce the possibility of error of the "personal" type, the less flattering but uncontroversial method described above has been adopted.

No account is taken of the result of treatment of any admission except the first for each case in this selected period. By disregarding the "cures" which followed the treatment of subsequent attacks, an artificial increase of cases showing no relapse has been avoided. Had the second attack, for purposes of treatment and observation, been regarded as another "case," the relapse rate would have been still further (but fallaciously) decreased. Each individual (except as regards reinfection with a different type of parasite, as mentioned above) appears only as a single case in the tables.

(*b*) *Details of Findings.*—The total number of British "Other Ranks" who were admitted for malaria during the period was 2,795. Of these, 323 relapsed, giving a relapse rate of 11·6 per cent. This is a crude figure which embodies several fallacies, and it is given merely for purposes of comparison. It includes cases of "clinical" malaria, a diagnosis which, in an analysis of this kind, is obviously unsatisfactory. It also includes cases admitted and treated for the first time in 1935, some of them "delayed" cases appearing in the early months, others primary cases occurring in May and June. In neither type is a sufficiently long period of observation possible. Finally, it includes three fatal cases, none of whom, it may be mentioned, had been treated with plasmoquine.

All these cases have been excluded from the subjoined tables, which deal exclusively with microscopically confirmed cases of malaria admitted to hospital during the last six months of 1934, and observed until the end of June, 1935. There is thus a minimum period of observation of six months; but, as most cases occurred from July to October, the average period of observation is approximately nine months.

In the tables cases are divided into three categories according to the treatment employed: namely, those which received the standard atebrin-plasmoquine course, those which received the standard quinine-plasmoquine course, and those which were treated by other methods.

In modification of the atebrin-plasmoquine course quinine was frequently given for a few days prior to beginning atebrin, or for two or three days along with atebrin, the object being to control the fever more rapidly.

The routine quinine-plasmoquine treatment in cases of benign tertian malaria was of fourteen or twenty-one days' duration, in accordance with the experiment which was being made. In malignant tertian malaria any form of quinine treatment combined with, or followed by, plasmoquine is accepted in this category.

Under the third heading are grouped together cases treated by other methods. Of the 188 cases of benign tertian malaria in this group, 101 were treated by one of two special courses which will be detailed later. The remaining 87 cases received various courses of treatment, the majority receiving quinine alone. In most of these cases this treatment was given, not because of any undue severity or peculiarity of the case, but mainly, it would appear, because the medical officer in question lacked faith in the standard treatments. Most of these cases came from stations where malaria is rare, and experience in its treatment slight. The malignant tertian cases in this category were not given plasmoquine.

BENIGN TERTIAN MALARIA.

Table II gives the total figures relating to cases of benign tertian malaria.

TABLE II.—RELAPSE PERCENTAGES IN BENIGN TERTIAN MALARIA.

Total cases			Atebrin-plasmoquine			Quinine-plasmoquine 14 days			Quinine-plasmoquine 21 days			Quinine-plasmoquine (total cases)			Other forms of treatment		
Cases	Rel.	Per cent	Cases	Rel.	Per cent	Cases	Rel.	Per cent	Cases	Rel.	Per cent	Cases	Rel.	Per cent	Cases	Rel.	Per cent
1,905	254	13·3	944	106	11·2	236	24	10·2	537	73	13·6	773	97	12·5	188	51	27·1

The figures shown under the heading "Cases" are those of the total number of individuals admitted to hospital. The relapses comprise those individuals in this group who had one or more subsequent attacks.

The ratio of relapses would be even lower were it not for the very bad results given by two units: the 2nd Royal Scots in Quetta, and the 2nd Green Howards who spent the first part of the year in Poona and thereafter moved to Meerut. For purposes of comparison and discussion, the details of these units, and of certain others stationed in malarious cantonments, are embodied in Table III.

The figures of the Royal Scots and of the West Yorks are in striking contrast. These units lived in barracks which were only a short distance apart, both in an area described in the recent Malaria Survey of Quetta as

TABLE III.—RELAPSE PERCENTAGES, BENIGN TERTIAN MALARIA, IN CERTAIN SELECTED UNITS.

Unit	Station	Atebrin-plasmoquine treatment			Quinine-plasmoquine treatment			Other forms of treatment			Total		
		Cases	Rel.	Per cent	Cases	Rel.	Per cent	Cases	Rel.	Per cent	Cases	Rel.	Per cent
2nd Royal Scots ..	Quetta ..	28	8	28·6	63	24	38·1	3	2		94	34	36·2
1st West Yorks ..	Quetta ..	17	0	0	31	3	9·7	3	1		51	4	7·8
2nd Green Howards	Poona-Meerut	25	13	52·0	3	0	0	1	1		29	14	48·3
1st Royal Warwicks	Poona ..	12	3	25·0	3	1		2	0		17	4	23·5
2nd Essex	Nasirabad	39	4	10·3	43	1	2·3	0	0	0	82	5	6·1
1st King's	Jubbulpore	27	1	3·7	23	2	8·7	2	1		52	4	7·7
1st K.S.L.I. ..	Delhi ..	52	5	9·6	8	0	0	48	11	22·9	108	16	14·8
2nd P.W. Vols. ..	Allahabad	47	3	6·4	0	0	0	0	0	0	47	3	6·4
2nd H.L.I. ..	Peshawar	6	1		40	4	10·0	2	1		48	6	12·5
1st Hampshires ..	Rawalpindi	38	3	7·9	2	0	0	2	2		42	5	11·9
Royal Artillery ..	Various ..	249	30	12·0	201	31	15·2	47	9	19·1	497	70	14·1

being "relatively favourably situated and which would be expected to be comparatively free from malaria, if proper precautions be exercised." The men were treated in the same hospital, and presumably their post-hospital treatment was equally supervised.

In one important respect, however, they differed; for whereas the West Yorks arrived in Quetta in the winter of 1934 from Egypt—where their malaria incidence was low—the Royal Scots were in Quetta during 1933, when malaria, owing to unusually adverse climatic conditions, reached epidemic level. Of the 34 Royal Scots who relapsed in the 1934-35 period,

TABLE IV.—MONTHLY INCIDENCE (ACTUALS) OF FRESH AND RELAPSE CASES, BENIGN TERTIAN MALARIA, IN CERTAIN UNITS.

	July		Aug.		Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apl.		May		June	
	F.	R.	F.	R.	F.	R.	F.	R.	F.	R.	F.	R.	F.	R.	F.	R.	F.	R.	F.	R.	F.	R.	F.	R.
Royal Scots (Quetta)	24	—	25	11	34	8	10	6	—	3	2	3	1	2	—	2	—	2	—	3	—	3	4	5
West Yorks (Quetta)	11	—	18	—	14	—	5	—	2	—	2	—	1	—	—	—	—	1	—	1	1	—	1	2
Green Howards (Poona-Meerut)	25	—	2	—	—	—	1	—	1	—	—	2	5	1	—	2	—	1	6	3	3	5	—	3
Royal Warwicks (Poona)	13	—	2	—	2	—	—	—	—	—	—	—	—	1	2	1	3	1	1	1	—	—	6	—

Note.—Multiple relapses, and cases having a first admission in 1935 are shown in this table, the totals in which therefore disagree with Table III.

(F. = fresh infection. R. = relapse.)

20 had malaria in 1933. It might be suggested that most of these cases were relapses from 1933 infections; but against this is the fact that only 7 of the 34 cases suffered from malaria in the January to June period of 1934, which is the season when benign tertian relapses may be expected.

A possible solution emerges when these relapses are classified according to the months in which they occurred. This is shown in Table IV where, for convenience, the Poona figures, which will be discussed later, are also included.

It will be seen that in the case of the West Yorks, the Green Howards, and the Royal Warwicks, relapses occurred mainly in the second half of the period, which is as would be expected. In the case of the Royal Scots, however, most of the so-called relapses were in the first half, and in the following June, i.e. in those months when fresh infections occur. When the state of affairs elsewhere is considered, it is difficult to avoid the conclusion that most of these cases were reinfections, and not relapses; but whether due to some local condition favouring a high carrier rate in the mosquito population, or to lowered resistance resulting from previous infections,[1] it is not possible to say. If these July to December cases are accepted as reinfections and not as relapses, the relapse rate declines to the average level elsewhere.

The Royal Scots' figures are the cause of the high relapse rate for the twenty-one-day course of quinine-plasmoquine shown in Table II. Excluding the Royal Scots, the percentage under this heading for the rest of India is 10·3.

As regards the Green Howards, we have searched in vain for a satisfactory explanation of this unusually large number of relapses. In the January to June period there are not only numerous relapses, but also numerous fresh cases, of which the January ones, at least, must be "delayed" attacks. The picture corresponds exactly with that which commonly follows the liberal use of "prophylactic" quinine, but inquiry has failed to elicit any information to the effect that this measure was employed. The local authorities incline to the opinion that these were reinfections; and certainly climatic conditions in the second half of the period were abnormal, and, for part of the time, within the limits of temperature and humidity in which fresh infection can occur. Further, gametocytes were found in the slides of only 8 of the 22 cases occurring in January to May, inclusive. Nevertheless, we are diffident about accepting this explanation, especially as, in this period, the British cavalry in Meerut had no cases at all; and the Royal Warwicks, who remained in Poona, had results shaping in the same way as the Green Howards.

It is of interest that none of the Green Howards' cases which relapsed

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[1] We are aware that this is not in conformity with the views expressed by the Malaria Commission, Health Organization, League of Nations, on the subject of immunity in malaria.

between January and June, 1935, have had any further attacks up to the end of 1935.

The other units from Southern, Eastern and Northern Commands, whose figures are included in Table III, are selected because they have the highest malaria incidence in these Commands. The relapse rates indicate the results which may be expected with these standard courses of treatment under normal Indian conditions. The Burma figures are too small to be worth recording.

In eighteen out of forty-four regiments of British infantry, no cases treated by these standard courses had a second admission for malaria within the period of observation.

The figures of the Royal Artillery are of particular interest, representing as they do the sum of the results in a number of stations throughout the country. The average gunner leads a much more exposed and strenuous life than his comrade in the infantry ; he works harder and longer in all weathers and he is largely deprived of the benefits of the move to the hills during the malaria season. These disabilities are reflected in the higher incidence of malaria per 1,000 in the artillery. The infantry and gunner average admission ratios (malaria all types) calculated on official strength returns, are 43·4 and 76 per 1,000 respectively. The slightly higher relapse rate in the artillery is possibly associated with: (*a*) a higher proportion of reinfections ; and (*b*) difficulty in carrying out post-hospital treatment. Even so, the close correspondence between these figures and the all-India average is very striking.

Other Courses of Treatment.

At the request of certain officers who were interested, two special courses of treatment were tried out. The figures which are now given relate only to cases of benign tertian malaria whose first attack in the prescribed period received these special treatments. It is hoped that full details of the experiments will be published in due course by the officers concerned.

The first of these courses was identical with the official atebrin-plasmoquine course, expect that the atebrin was replaced by quinine, either 20 or 30 grains per day being given according to the circumstances of the case. This experiment was carried out with the greatest care. In all, 57 " first attacks of the year " were treated between July and December, 1934. Of these 12, or 21 per cent, had relapsed before July, 1935. In one regiment, where conditions of treatment, etc., were alike for all, 52 cases were treated by atebrin-plasmoquine, and 48 by the above special treatment : of the former only 5, or 9 per cent, relapsed, but of the latter 11, or 22·9 per cent.

The second special treatment was that advocated by Knowles (1931) namely, alkaline mixture followed by quinine ten grains, twice daily for ten days, with plasmoquine 0·01 gramme daily for the last six days.

In the period under analysis 44 cases were treated in this way, of whom 11 or 25 per cent relapsed.

In both instances, therefore, although the treatment included plasmoquine, the results fall short of those given by the standard courses recommended by Army headquarters.

Number of Relapses.

The number of relapses suffered by the 254 cases who had more than one attack is shown in Table V.

TABLE V.—NUMBER OF TIMES INDIVIDUAL CASES RELAPSED: BENIGN TERTIAN MALARIA.

Number of cases having :—	Atebrin-plasmoquine treatment	Quinine-plasmoquine treatment	Other forms of treatment
1 relapse	87	81	41
2 relapses	17	11	8
3 relapses	2	4	2
4 relapses	—	1	—

To put this in another way: over 82 per cent of the cases which were not cured by a first course of treatment had only one relapse during a period of observation averaging nine months.

Seasonal Incidence of Relapses.

The number of relapses occurring in different months is shown in Table VI.

TABLE VI.—MONTHLY INCIDENCE OF "RELAPSES," BENIGN AND MALIGNANT TERTIAN MALARIA.

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June
Benign tertian ..	2	29	34	35	29	32	17	21	26	31	25	39
Malignant tertian	0	4	8	9	8	8	2	1	1	0	1	0

Both first and all subsequent relapses which occurred are shown in this table. The significant feature is the absence of any wave of "spring fever." There is no doubt that a proportion of the autumn, May and June cases are reinfections but, with the details at our disposal, this is not capable of proof.

MALIGNANT TERTIAN MALARIA.

Malignant tertian malaria is normally less liable to relapse than benign tertian, particularly as far as "long-term" relapses are concerned.

Nevertheless, with only quinine treatment, relapses occurring soon after the primary attack are by no means uncommon.

Table VII shows the results obtained by the standard courses of treatment.

Where the number of cases is sufficiently high, the figures of individual regiments—from which this table is compiled—correspond fairly closely with the average in Table VII. The only exception is provided by the 1st Gloucestershire Regiment at Mhow, where seventeen cases occurred with six relapses. It is difficult to discover the exact cause of this but, in view of the uniformly good results obtained elsewhere, it seems probable that it is referable to some local circumstance which is of no general importance.

TABLE VII.—RELAPSE PERCENTAGES IN MALIGNANT TERTIAN MALARIA.

Atebrin-plasmoquine			Quinine-plasmoquine			Other forms of treatment			Total		
Cases	Relapses	Per cent	Cases	Relapses	Per cent	Cases	Relapses	Per cent	Cases	Relapses	Per cent
216	21	9·7	185	14	7·6	41	4	9·8	442	39	8·8

As previously mentioned, no hard and fast quinine-plasmoquine course for malignant tertian malaria was laid down. The general recommendation made from time to time by Army Headquarters was that, where this form of treatment was adopted, quinine should be given as indicated by the individual circumstances of the case ; and should be followed by 0·03 gramme of plasmoquine daily for five days, to be repeated after an interval if gametocytes were still present. This was carried out in a number of cases ; in others, either the standard fourteen-day or twenty-one-day course was given ; and others were treated by Knowles' method. All patients who were treated with quinine, accompanied or followed by plasmoquine, are shown under this heading.

The results with quinine-plasmoquine treatment appear the most favourable, but the numbers are too small to permit of any definite conclusions being drawn ; and it will be noticed that, in the small group of cases treated without plasmoquine, almost equally good results were obtained.

TABLE VIII.—NUMBER OF TIMES INDIVIDUAL CASES RELAPSED: MALIGNANT TERTIAN MALARIA.

Number of cases having :—	Atebrin-plasmoquine treatment	Quinine-plasmoquine treatment	Other forms of treatment
1 relapse	17	14	3
2 relapses	3	—	—
3 relapses	1	—	1

The number of relapses from which the various cases suffered is shown in Table VIII.

The monthly incidence of all relapses is shown in Table VI. It will be seen that the majority occur between August and December.

QUARTAN MALARIA.

The number of cases of quartan malaria is too small to be of significance, and the figures relating thereto are quoted merely as a matter of interest (Table IX).

TABLE IX.—QUARTAN MALARIA RELAPSES.

Atebrin-plasmoquine treatment			Quinine-plasmoquine treatment		Other treatments	
Cases	Relapses	Per cent	Cases	Relapses	Cases	Relapses
17	2	11·8	1	1	1	—

The three relapse cases remained apparently cured after their second course of treatment.

MIXED INFECTION.

Here also the material is scanty; but the figures, in so far as they go, show a tendency towards a higher relapse rate than occurred in simple infections (Table X).

TABLE X.—MIXED INFECTION RELAPSES.

Atebrin-plasmoquine treatment			Quinine-plasmoquine treatment			Other treatments	
Cases	Relapse	Per cent	Cases	Relapses	Per cent	Cases	Relapses
24	5	20·8	14	3	21·4	2	1

Of the 9 cases which relapsed, 7 remained free from attacks after their second course of treatment, and 2 were admitted in all 3 times each.

TOXIC SYMPTOMS.

The toxic signs and symptoms noted among these cases are shown in Table XI.

TABLE XI.—TOXIC SIGNS AND SYMPTOMS WHICH FOLLOWED THE ADMINISTRATION OF THE SYNTHETIC DRUGS.

	After atebrin alone	After atebrin-plasmoquine	After quinine-plasmoquine	Total
Colic	3	17	11	31
Colic and vomiting	2	—	—	2
Colic and diarrhœa	1	—	—	1
Diarrhœa	—	—	1	1
Colic and cyanosis	—	3	—	3
Cyanosis	—	5	6	11
Tachycardia	—	1	1	2
Transitory albuminuria ..	—	1	—	1
Hæmoglobinuria	—	1	—	1
Total	6	28	19	53

At first sight this may appear a somewhat formidable list. Actually, however, it is not. In the colic and diarrhœa group there is no evidence whatever that the symptoms were caused by the drugs and, knowing the frequency with which gastro-intestinal disturbances and other minor disorders occur in the soldier in India, it is surprising that a longer and more striking list of signs and symptoms, coincident with these malarial attacks and treatment, cannot be compiled.

In the majority the symptoms were trivial and quickly disappeared. Indeed, were it not for our desire to mention every point of possible interest and relevancy, it would not be necessary to set down any of the items in this list, except hæmoglobinuria. In some cases the treatment was not interrupted: in others it was omitted for a day or two until the symptoms subsided. Details of the case of hæmoglobinuria are given in the Annual Report on the Health of the Army, 1934, page 127. Of the 53 cases, this is the only one which can be regarded as in any way serious, or calling for special remark.

No cases of "cerebral excitement" of the type described in Malaya have been reported.

Yellow discoloration of varying degrees occurred in a few cases treated with atebrin, but this was not associated with any untoward symptoms.

There is nothing to suggest that the toxicity of plasmoquine was in any way enhanced by being given immediately after a course of atebrin.

(*To be continued.*)

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MEDICAL TACTICS IN MOBILE WARFARE.

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LECTURE II.—LOCAL MOVEMENT.

Jericho—Jordan—Moab.

Some days of intense local fighting followed the fall of Jerusalem. Then the Turks were beyond range of the Holy City. They counter-attacked hard and more than once. Their last assault was followed by a further advance on our part and the Egyptian Expeditionary Force then settled down to a period of stationary warfare which so far as the Army as a whole was concerned lasted until the following September (1918). During this period, however, there were certain local movements involving extreme mobility, in all of which the 60th Division was engaged.

I ended the last lecture by speaking of *elasticity*. To acquire and maintain elasticity should be the aim of every officer and of every formation from a squad to an army corps. It is an attainment that to my mind is as important in peace time as in war, and is as applicable to the conduct of a difficult case in medicine as it is to a military problem. Elasticity can be obtained and maintained only by constant training, and I want to put before you what I think are the most important things in the training of a field ambulance.

In the week before the War broke out the University of London O.T.C. was in camp. A regular combatant officer whose name I have forgotten, and who was killed in the retreat, was attached and brought down a book that was just published. It was "The Principles of War" in two volumes by Major-General Altham. I looked through it, never dreaming that it would be of use to me. Next week the War had broken out, and wanting to fit myself for it I got this book out from the library and read it. To many it will seem absurd that a young captain of the R.A.M.C. should read about the Principles of War. But Abe Lincoln read Clausewitz; and we of the O.T.C. had all read Henderson, both his "Stonewall Jackson" and his "Science of War." I believe that if you are going to do a job it is well to know something about it. Perhaps I did not understand much of Altham's Principles, but at the end were two additional chapters, one on Training and one on Billeting. That on training impressed me very much. It told of a brigade of the Japanese Army, that had been more highly and more strenuously trained than any other in the Japanese Army. It performed feats of marching and of fighting that one would have thought unbelievable, until one had experienced similar feats oneself. The training of this brigade remained in my memory throughout the War,

and I tried to emulate it in a small way in my field ambulance. The lesson learnt from it was confirmed by watching other units. I noticed that those which began to creep ahead were those that trained hardest. I learnt from General Bulfin that the health of a unit depended primarily upon its administration, and I learnt from observation that efficiency for its purpose depended chiefly upon its training. This lesson was confirmed by General Shea, who trained the 60th Division with an extreme intensity in August, September, and October, 1917. He came to me and asked me whether I thought he was training too hard and whether the 179th Brigade was beginning to go stale. He knew that the first sign of this would be an increase in the sick parades and of numbers going down the line through the field ambulance. I told him the pitch was pretty high, but there was no sign of staleness at that moment; he told me to let him know at once if I saw any evidence of it.

Training must never end. After the most strenuous activity two days' rest may be given, after that it should begin again, gently at first, but it should begin even if it be known that movement and action are to start again next day. These then are the points upon which I would concentrate in addition to first aid which is part of the technical training and is analogous to musketry in infantry.

(1) *The Carriage of Wounded.*—This must be practised by all methods, but especially on stretchers. You must practise carrying them with any number of bearers in the squads from two to six and with each man in every position, and you must practise them over the most difficult obstacles you can find. There were some water-cress beds at Watford. There was a high iron paling with spikes in Audley End Park. There were walls, hedges and ditches wherever we were in England. In Salonika there was a hill outside our camp over which we used to scatter "wounded" when the infantry had done attacking it. But nowhere were there obstacles so formidable or ground so difficult as what we found on the Judæan hillsides.

(2) *The Movement of Stretcher Squads.*—Six to ten stretcher squads are about the most difficult formation to move rapidly that there is. The two men attached to the stretcher make them so. They are much more difficult to handle than a platoon or a company. To get them through a gate or an orchard, to get them over a bridge or a lock-gate, or rapidly to get them off a road or track to allow transport to pass requires a high degree of training and constant practice. The official stretcher drill can never be enough to cover every eventuality, you must make a drill of your own and practise it until your squads move spontaneously without bunching like a flock of sheep; and you must practise it with each man in a different position in the squad, and with different men in each squad. Specialization in this matter is the antithesis of elasticity.

(3) *Loading Vehicles.*—This again you must practise with all sorts of vehicles with any number of men. Here, however, specialization may add

to efficiency. You will always have a certain number of men, perhaps older than the rest, flat-footed or short of breath who are classed as bearers but cannot carry far. They cut up bacon or mend boots and see to the lamps. You cannot do without them and you get them along somehow. The convoy arrives, the whistle goes, they drop their bacon and their boots and shuffle along to the wagons from which they take the stretchers and hand them on to more agile bearers to carry in or out of the dressing station. And standing there by the tailboards of the wagons by long practice they acquire gentleness and remove the wounded more gently than the ordinary bearer. It is difficult not to jerk the stretcher as it comes out. This is most painful to the patient and requires special skill to avoid.

(4) *Finding the Way.*—This comes natural to some, and others are bad at it. The good, however, improve and the bad acquire some benefit by practice. Take out a body of men just before dark. They march at ease, but have to pay attention to the route. Beyond each defile or cross-roads halt them, turn them around and point out the characters of the spot as seen *on the return journey*. Bring them back after it has become dark and show them the same spots in the altered light. Then send them out another night in twos and threes to report at the point reached previously and again on return. It does not need much imagination to vary this from a few hundred yards to several miles, in daylight, moonlight, starlight and the dark. Lastly take them out before dawn and bring them back as it is getting light. The morning half-light is very tricky, more so I think than dusk, perhaps because we know it less. But it is very lovely, even at its worst. Officers and senior N.C.O.'s must be trained in finding their way at night by the stars or by compass. Have out also the cooks, the clerks and the men in the quartermaster's office. They may some day have to find their way in the dark, and it keeps them fit and alert.

(5) *The Care of Equipment.*—Please to remember this is done *not* by hoarding, it but by getting it out and practising its use. You must have everything out of every pannier time and time again. You must do it by the way-side, in tents, in buildings, in an open field or on a broken bit of ground. You must start doing it slowly and by daylight. You must continue at dusk and by full moon; you must finish in the dark and in a hurry. The day after such training every pannier and piece of equipment must be checked and steps taken to replace anything that is lost.

This form of training will be very unpopular. Quartermasters are worthy fellows; but having got equipment complete they hate the idea of losing any. Serjeants in charge of panniers keep the keys in their pockets and will not let them out. Both these hang on especially to small things such as needles. Because these are easily lost they must all the more be had out. Your officers will not like sitting on the Boards necessary to replace things lost. Even Divisional Commanders will comment on such losses, and suggest that someone should pay for them. In spite of all this you must do it. If you do not you will lose all the important details of

equipment on the first day they are used in earnest; and on the next day you will be valueless as a unit for tending the sick.

(6) *Combined Training with Combatant Troops.*—It is often difficult to arrange this. A field ambulance is always in action looking after the sick of the troops. It should, however, be possible to do this with one section. Another should always be available for training. If you cannot get out with a brigade get out with a battalion. When there is divisional training you will be ordered out, but at other times you must find it. The general staff tend to forget you, and commanders of units or small formations do not want you and do not realize that you need to be trained. They are, however, willing to have you so long as you do not get in the way. The value of this training is chiefly for yourself and for your senior officers; for the men it is more a day out and a picnic, unless it is raining. Remember always to go to the pow-wow at the end. At first you will be laughed at, then tolerated. Finally your presence will be appreciated. It is well for you to know the meaning of what is going on, and it is well for you to get to know the officers of the units with whom you have to work. This personal touch is a great asset when they commit their men into your charge.

Personally, I believe that from time to time there should be exercises designed to study medical tactics, where one or two field ambulances form the basis of a scheme and a battalion of infantry is used to represent a division or brigade with a battery as divisional artillery. The whole attention of the staff, as well as the A.D.M.S., would in such a field-day be given to the disposal of the Medical Services, with perhaps supplies and ammunition added. Until you can get this, however, you must do your best by going out when others do. I might say, however, that issuing labels and collecting imaginary wounded on such occasions is, in my experience, of little or no value.

With these somewhat lengthy preliminary remarks let us return to the 2/4 London Field Ambulance in the Holy City, with the main dressing station located in a good building, and see the purposes to which such a unit can be put.

(*a*) It was some time before evacuation was possible, and when possible the nearest hospital was so far away that it was death to a serious case to send it down. Our dressing station had therefore also to become a hospital complete with an operating theatre, fit for Colonel Wade, the consulting surgeon who came up. (*b*) The various Turkish hospitals were allotted to the different field ambulances. Within the old city were two that came under our care. One was a quarantine hospital containing tetanus cases. It afforded a terrible sight. We had to staff it completely, for the personnel left behind by the Turks had disappeared and merged with the civilian population. The other was staffed by the members of the American Colony in Jerusalem. We had but to supervise and after it was emptied to dispose of the equipment, much of which we used. This had been done

by Christmas. (*c*) We could not evacuate the slightly sick. A huge empty convent was therefore converted into a convalescent home. This was equipped and staffed by one section of the ambulance. (*d*) The louse problem was upon us. At the back of our hospital was a laundry. This also we had to run. The difficulty was fuel. At this time the problem of fuel in Jerusalem was as difficult as the water problem had been at Sheria. Of course it was not so vital. We ran this laundry largely with dried orange peel. The oranges of Jaffa were just in season and the local population did a roaring trade with the hungry troops. (*e*) Nothing was coming up the line except bully beef and biscuits, and ammunition. Boots were becoming a difficulty both for my own men and for those we were returning to the units. When we began to evacuate we took the boots of every lying case for re-issue; thereby incurring the wrath of sundry base details as there was a regulation against this. In addition our cobbler mended over one hundred pairs with leather stripped from some Turkish pack-saddles that the Brigadier had discovered in a barn near Huj and had told me about. (*f*) We were responsible for the sick of all the scattered details and small units on the road between Jerusalem and Hebron, a distance of twenty miles.

These multitudinous activities show a high degree of elasticity upon the part of the field ambulance. I have always been very proud that the men that I had trained rose to these emergencies which had never entered our minds until we encountered them. But you must also remember that it was the organization laid down as the result of experience in the South African War which enabled us to do all this. I think sometimes we are not grateful enough to those of the generation before us who laboured quietly out of the limelight between the years 1902 and 1914. They provided a unit capable of the highest elasticity, that stood the strain when there came the need for it, and therein is their reward.

You may ask what all these activities have to do with tactics. The answer is that firstly they exemplify the period of cessation of movement after an advance. The greater the pace the greater the stasis, and our pace had been pretty hot, although nothing compared with what Allenby did a year later. Secondly I was immobilized. To retain the power to manœuvre is the aim of every commander. The more he can do this the greater his chance of success. Now I do not say that a field ambulance that has developed into something like a stationary hospital will immobilize a division, but it will certainly limit the power of the Divisional Commander to manœuvre. It was on a day early in February, 1918, that the A.D.M.S. said to me, "It looks as though we shall be on the move again soon. I suppose you can move at forty-eight hours' notice." "Good God, no!" I replied, or words to that effect, "I am dug in and it will take me a fortnight to get myself out again."

During this time we had to carry on with our ordinary duties of dealing with the sick of the brigade group and of providing bearers and an advanced

dressing station when the Turks attacked. General Headquarters always knew when this was going to happen and when it was to be put off so we did not have to waste personnel by keeping these in permanent readiness. Two episodes may be mentioned. The first was the garrison of a monastery to the south-east of Jerusalem called Ibn Obeid. An officer, a serjeant, and some half-dozen orderlies were included in the garrison. Rations went out under escort on alternate days and the sick were brought back under the same escort. The men loved it, and "As good a war as Ibn Obeid" became a term of approval.

The other was a reconnaissance in force towards Ali El Muntar and the Mar Saba gorge. This brings me to the tactical problem of protection, and we may summarize this as a medical problem here. Of the services that have to be protected—supplies, ammunition columns and medical units—we are the only one that cannot protect ourselves at a pinch. It is up to us to see that we do not unduly expose ourselves. I have told you how on one occasion—owing to finding a road across a wady—I bivouacked in no-man's-land. I was proud of it at the time and resented having to move at dawn, but I ought to have been ashamed of myself. I have told you how at Ain Karim my A.D.S. was far out on the right flank, so that had the Turks got around that flank they would have been on us in the dark and our red cross brassards would have been no protection. For though the red cross protects us from bayonets, it does not protect us from being mopped up as prisoners. At Ain Karim I do not think we could have avoided being in an exposed position. The advanced dressing station made itself and being made could not be moved. We may cite these as negative instances of protection.

But there is a positive aspect as well. We have to get in any casualties from the protecting troops. This may be a ticklish job if they are driven rapidly in and careful preparations should always be made for any reconnaissance. At the Beersheba reconnaissances these were made. The Desert Mounted Corps always had out a whole cavalry field ambulance with the covering troops. On this occasion we had no medical personnel out at all. I had received no copy of the orders dealing with it, but I knew about it unofficially and went out myself with the brigade staff. Two battalions were taking part—half the brigade. The screen was some ten thousand yards away from Jerusalem when there was a burst of firing from a hill opposite and some enemy were seen rapidly to retire. One person only was hit, the Brigade Major with a serious wound in the thigh. He was carried nearly into Jerusalem. It was possible to put a whole company of infantry on to stretcher-bearing and his life was saved. But that is a question of minor importance. Suppose that that sudden burst of firing had resulted in twenty casualties instead of one. There would not have been stretchers or personnel to carry them away. The screen could not have retired. Suppose then the Turks had been more numerous or more adventurous, more casualties might have occurred. The

commander of the battalion would have had to hold on longer than he should have done on tactical grounds. He might thus have lost most of his battalion and involved the other battalion. Other battalions would have been hurried up and perhaps a large engagement would have developed resulting in movements of troops over the whole front and serious disturbance of the plans of the Commander-in-Chief, and all because preparations had not been made to have present a few R.A.M.C. personnel and a camel load of stretchers and splints. You may think I am making a mountain out of a molehill. I do not think so. I can see the scene to-day and it needs no imagination to envisage the development of a serious situation. I suspect that every disaster of small bodies of troops from Cremera to Isandula arose, if only we knew enough details, from a similar mistake upon the part of a minor subordinate. It has been said that the commander who wins is the one who makes the fewest mistakes. But if neither makes a mistake victory will go to the one in whose Army fewest mistakes are made by those in subordinate positions down to the junior lance-corporal. Everybody of my generation made mistakes in those four and a half years; but on looking back I believe that this was the biggest that I made, and I was fortunate not to have lost my command.

You may say that I was not responsible. That having had no orders, I should have been exonerated from the consequences. I hold it as an article of faith that no man can absolve himself of responsibility. One came across attempts to do so under two circumstances. The one is before an event, when someone finding a difficult job to be done goes to those above him and demands all sorts of things, perhaps unobtainable, and if he cannot get them, say, "Well then, I cannot be responsible for the result." Such a one is almost sure to fail. He is right to make his demands, but they must be reasonable. If he cannot obtain them he must do his best under the circumstances. If he fail it is for others, not for him, to assess responsibility. He can be sure that all factors will be considered. The other circumstance is such as this might have become, when after the event one finds one has not done something that one should have done; one cannot deny responsibility on the grounds of those above having failed to give some order. The Brigadier and Brigade Major were busily employed. I knew what was going on. I ought to have gone to the Brigade Major and asked what medical personnel the Brigadier wanted, and talked over what was needed.

It wàs in February that we began to move again. The first operation was the two or three days' fighting that pushed the Turks finally off the hill country and into the Jordan Valley. We call it the fall of Jericho for the historic association of the name rather than for any strategic importance of the place.

The main dressing station remained in Jerusalem. The stupendous nature of the ground gave the character to the operations. Transport could not be got far, and having got where it could, had to be brought all

the way back to Jerusalem before it could be used at another spot not far away. Fortunately we had no casualties in two out of the three engagements—the taking of Ali Muntar and the capture of Nebi Musa.

The first is a high hill some ten miles south-east of Jerusalem, from which the Jews used to set loose the scape-goat at the great Day of Atonement (Lev. xvi. 10). The other is a Muslim monastery in an open plain near to the Jordan Valley and above it at the north end of the Dead Sea. There was no cover for the attacking troops for half a mile around. Had it been occupied by Turkish troops with machine guns it would have been a ticklish job to capture it, and with the modern machine-gun casualties must be very high. Fortunately the Turks had evacuated it; and the London Scottish were in it before the artillery arrived. How these ever arrived at all to this day I do not understand. There were places across which the gunners must have carried both the guns and their horses so far as I could see. It is the supreme example that I have met of man's determination in the face of Nature.

Then we settled down again for a bit. The winter rains were not past; and to give you some idea what rain means in a wild country you may note that it took two days to get in a slightly sick man from a post twenty miles away. This post was on the Jebel Kuruntal, the traditional site of the Temptation. It is a hill that overlooks the Jordan Valley, from which you can see to your right the plain beneath you to the far end of the Dead Sea, while to your left the snow-capped peak of Mount Hermon juts up into the sky 120 miles away. The best way back was to descend into the valley and return by the Jericho road; but the Turks were not yet driven right on to the Bridgehead of the Jordan and we could not do that. The sick had to come over innumerable little knobs of limestone hills, on which any path that was made disappeared with the next rain. At the best it was a slippery glissade, along which man and camel had to walk straining their muscles not to slither down the side of the hill, first to the left, and then as they turned a corner down to the right. An advanced dressing station had to be opened at Makhmas—the ancient "passage of Michmash" (1 Sam. xiv. 4, 5)—where the sick man spent a night but little more comfortable than in his own bivouac.

A bit later the western margin of the valley was relatively safe for non-combatants. I recognized, from the mysterious behaviour of everyone at Divisional Headquarters, that there was something in the air. One day the A.D.M.S. came to me and said "We are going to cross the Jordan. We shall have to have a main dressing station on this side of the valley and I want you to select a site and send down all those beds and other equipment that came out of the Turkish Hospital." I replied "They are already there." I had loaded up all my wagons and sent them off with three days' rations and a party of men. They took two days to go down, and brought the empty wagons back the twenty-two miles on the third day. The site selected was the Jericho of the time of

Herod. There were on it masses of old walls of the palace in which he had entertained Cleopatra when she was returning to Egypt from across the Jordan Valley (Josephus-Wars 19-5).

The operations were in four stages. (1) Crossing of the Jordan. (2) Driving the enemy off the hill El Haud that overlooked the road at Shunet Nimrin and the track in the Wady Arseniyat up into Moab. (3) Taking the town of Es Salt. All these were successful. Distances are as follows: Jericho (our main dressing station) to the Jordan about 8 miles. Jordan to Tel Nimrin 7 miles and on to Es Salt about 15. (4) Cutting the railway at Amman. This was another 18 miles further on. The distance was therefore nearly 50 miles to get the wounded man into the main dressing station and 70 to the casualty clearing station which had now been brought up to Jerusalem. The development of the main dressing station into an operating centre is not a part of medical tactics and I do not propose to discuss it. This first trans-Jordan raid I would use as a text for impressing on you the importance of information and inter-communication, especially when things begin to go wrong. Our brigade had left Es Salt and been brought half-way back to the Jordan Valley when we were hurriedly pushed back there again. Things were not going well at Amman. At Es Salt there is an acute angled bend on the road, and it was thought that the Turks were getting round this bend to cut the communications of those up at Amman. My advanced dressing station became a stage in the line of evacuation for all the sick and wounded. The decision as to the time at which he would retire depended largely on the Brigadier learning from me that all the wounded had passed this point. The number was quite unknown to me. They were coming from a mixed force of infantry of our division and of a considerable body of cavalry. Now in the old Field Service Regulations there is no statement as to informing the medical services of the number of casualties to be expected or any instruction as to how this should be carried out. Nor was there any organization or equipment for keeping the field ambulances in touch with Brigade or Divisional Headquarters. I understand that with the new organization of the Royal Corps of Signals there is still no equipment for linking a field ambulance with either. And yet you see from these operations in Moab the knowledge of the number of casualties still not passed a certain point, and the communication of that knowledge to the General Staff may be of extreme tactical importance. Communication on this occasion was not difficult as Brigade Headquarters was in the next field to the advanced dressing station; but had the same need arisen in any of the other engagements that we have been considering the fact that there was neither equipment nor organization to keep me in touch with Brigade Headquarters would have made the transmission of news impossible without untold delay. During an engagement the strain on the signal service is great. We were supposed to hand any message we wanted conveyed to the nearest member of the signal service. How efficient this

was may be shown by the fact that a message that I handed to a dispatch rider going back to Divisional Headquarters at 9.0 a.m. on December 9 reached the A.D.M.S. to whom it was addressed at Divisional Headquarters after forty-eight hours. This question of linking up the medical services in the field units as a tactical problem needs thinking out in peace time. It cannot be improvised once a war has started. Remember that with the internal combustion engine dominating mobility you must be prepared for greater mobility, not less, and a subject such as this will become more important and more difficult.

The transmission of information to the medical unit must form part of such a study. It will always be difficult for rumour will come drifting by. On this occasion rumour was all that I had to go by. We had been going pretty hard since we had moved off on March 21 and on Saturday, March 30, we had had a fairly hard day. I was just turning into my bivouac when I had a message to go and see the Brigadier. He told me that he proposed to retire as soon as he heard from me that all the sick and wounded from Amman had passed Es Salt. It was about 10 p.m. on Easter Saturday that I took up my position at the roadside to attend to this. It was at about 10 a.m. on Easter Monday that I left it to tell him that I was now confident the last man had left. It is nineteen years ago and I cannot be certain as to details, nor whether some of the memories belong to the first night or the second. The dressing station was by the roadside. There were a few yards of level ground and then the ground began to rise in tiers of limestone like steps up the hillside. There was just room on the level for a row of camels to "barrack" and to move in and out. Behind the row of cacolets thus unloaded we could pitch just the few tents we had with us. The road was narrow. There was just room for two vehicles to pass. When we had transport being loaded two-way traffic was held up. A convoy came down from Amman. We took the cacolets off the camels. Fed and wrapped up in the cacolets, the wounded were covered with the cacolet covers. It rained all night, but these kept them fairly dry. They seemed to sleep soundly. The camels were grunting on a neighbouring area of moderately flat ground. At dawn we fed the patients again, loaded up the camels and sent off the convoy with a few of our bearers in charge. Some reached the valley fifteen miles away that night, the road was in the slimy mess that limestone takes on after rain. The camels slithered and slipped on it and some had to stay out all night. It was over twenty-four hours before these had gone the fifteen miles, and the two or three bearers had to unload and load again every one of these cacolets on to the camels. I think there were twenty or thirty of them. To do it properly takes six men to a camel.

Some time in that first night a convoy of supply camels had come up with rations. They were turning in to the same bit of ground as our ambulance camels had already partly occupied. It was just by the dressing station, and as they were turning off the road a battery of

artillery came down the other way. The retreat from Amman had begun. Artillery do not like being stopped and the leading gun tried to push in between two camels. The "chemozzle" was intense. I stood by the road trying to sort it out, and felt my right arm firmly held. First my humerus, then the muscles and skin, and finally my trench coat slipped from the grip. I turned and found it had been the jaws of a camel that had held me seemingly in so friendly a grasp. They say a camel's bite will break a man's arm. If so, it must have been the trench coat that saved me.

The camels being off the road the battery was halted opposite the dressing station, and we asked them to take some wounded on. They did not want to, but being told the men might otherwise fall into Turkish hands agreed; and we put a couple of slightly damaged men on to each limber and so got a dozen away. Next morning there came up a staff car. We pressed that also into our service, and persuaded the staff officer to take two wounded lieutenants down with him. Towards afternoon these two returned to us when a convoy of Ford ambulances came up. The car had broken down—or partly so—and the staff officer had handed them over to the leading driver. What a waste of transport when every seat was like untold gold. One of the boys had a broken arm splinted by being tied to his chest. It was on the second night that the 6th Field Ambulance came down. They were whacked and looking for a rest; but I could not let them have it and insisted on their going on without unloading the men they had in their desert sand-carts. I feared the delay of a single man for a single minute. At dawn on Easter Sunday the people of Es Salt had begun to get wind of our retirement and some who had welcomed us unduly began to flee. First in twos and threes with a donkey overloaded and a cow. Then more of them and by this second night in numbers great enough to block the road and seriously to interfere with our work. This was but a small retreat but gave me some idea of what those early ones in France and Belgium had been. And all this time I could get no news of how many more there were to come. Several times I was told these were the last; and every time this news was followed by a rumour of some great number lying out untended. Sometimes it was one hundred; more than once it was five hundred and I began to fear some great disaster had befallen us. I do not think it was raining on this second night, but it was cold and I remember just at dawn the Brigadier coming over to my camp I think for company's sake for he was the only one awake at Brigade Headquarters except the signal men on duty. He sat down before the glowing embers of a fire, a hunched figure with his face haggard and drawn We stirred up the fire and got him some hot coffee.

A few hours later it all seemed a dream, the sun came out and warmed us through. By 10 o'clock the news that all had passed seemed reliable. Our own bearers that had been on to Amman had rejoined us. We sent off the tent subdivision early, and kept the ambulance carts with some of those

of the 6th Field Ambulance that the A.D.M.S. had sent back to us. That evening the Brigade retired and by Tuesday night everyone was back across the Jordan; back as we were on March 20, except that the Bridgehead was no longer west of the Jordan in Turkish hands, but east of it in British. As we had recrossed the Jordan we heard the news of the March retreat in France.

So much for Information and Inter-communication. It is interesting to note that the Brigadier of this period (now Lieutenant-General Sir E. T. Humphreys) always insisted on his signal officer connecting me with Brigade Headquarters as were the other units of the Brigade Group. In France he had been G.S.O.I. to the Division and when the A.D.M.S. had asked him for this very connection he had refused it. When I taxed him with inconsistency he answered "No! he had always wanted it; but the equipment allowed did not provide for it; and in France he had needed every bit of signal equipment for keeping touch between the infantry and gunners. By the time we had been overseas everyone had 'made' a bit of extra equipment, and it was this that he used to keep touch between Brigade Headquarters and the corresponding field ambulance." I say again that this is a question that must be thrashed out in peace time. The want of it may result in the loss of a brigade if ever there is another great war.

Of the second trans-Jordan raid there is nothing tactical to say. It was an unsuccessful attack with considerable loss on the same hill—El Haud—that had previously been taken with some fifteen casualties. It illustrated, however, the use of the Red Cross. We had had orders that this was not to be flown at the advanced dressing station as it had been learnt that the enemy were in the habit of calculating the number of troops engaged by the number of Red Cross Flags flying. In open country such as the Jordan Valley the absence of the flag was a great loss in the collection of wounded. It could be seen from afar and the bearers made straight for it. But its absence had another disadvantage. The advanced dressing station was pitched on the same spot as in the first trans-Jordan raid when the Red Cross had been flown and no shell had come near it. On the second trans-Jordan raid shells were bursting around the advanced dressing station for four days seriously interfering with the work. On this fourth day the A.D.M.S. visited the advanced dressing station and seeing the situation ordered the flagstaff to be erected and the flags flown. Not another shell fell anywhere near its vicinity.

The main dressing station was in the same place, in Herod's ancient palace. It was enlarged to act as the main dressing station of the whole force—viz., the Desert Mounted Corps and the 60th Division. On the ground was spread a large Red Cross flag belonging, I believe, to the Australian operating unit that was attached to us.

Every morning soon after dawn enemy planes flew down the valley bombing the huge Camel Corps camps that could not be hid. Arrived at

the north end of the Dead Sea they turned west to the Hills and flew back north searching the edge of the valley beneath these hills with bombs. As they came to the mouth of the Wady Kelt where our camp with its Red Cross lay they ceased dropping bombs, swerved out into the middle of the valley and back to its hillside margin north of our camp. Then they started bombing again.

In all Allenby's campaign in Palestine these two Trans-Jordan raids were the only operations or engagements that were not completely successful. It has always seemed to me a measure of his greatness that he used his two failures for his final success by making the enemy believe that he still intended to make his main attack by this route once more. Whereas he broke the Turkish line on the other flank on the sea-coast. Again he used the 60th Division; but it was no longer the same. It had been converted from a second line Territorial Division into a British and Indian one. In the conversion my field ambulance had, alas, been broken up and I had become a M.O. in the wards of a base hospital. I fear, therefore, I have no tactical lessons to tell you from the campaign of the autumn of 1918.

REPORT ON MAXILLO-FACIAL INJURIES.

In May, 1932 the Army Council appointed a Committee to report on facilities for the treatment of wounds to the jaws and face which occur in modern warfare.

The constitution of the Committee was as follows:—

Chairman: Colonel J. P. H. Helliwell, C.B.E. Members: Mr. W. Kelsey Fry, M.C., M.R.C.S., L.D.S.; Sir Harold D. Gillies, C.B.E., F.R.C.S.; Mr. W. Warwick James, O.B.E., F.R.C.S., L.D.S. Secretary: Major S. H. Woods, O.B.E.

The main subjects to be investigated by the Committee were :—

(i) The provision and equipment of special hospitals or departments for maxillo-facial injuries.

(ii) General methods of treatment.

(iii) The training of dental officers in the principles of preliminary treatment in the field.

At the suggestion of Colonel J. M. Weddell, K.H.S. who attended the Committee, the Section of the Report dealing with general principles of treatment is published for general information.

General Principles of Treatment.

In the Field and up to Admission to a Special Hospital.

It could be assumed that in these cases it would only be practicable to give first aid until the wounded had reached a main dressing station, which might be some hours after the wound had been received. We make the following recommendations :—

Preliminary Treatment.

In the early stages preliminary treatment would be entirely restricted to "life saving" and would chiefly entail the prevention of suffocation and the arrest of hæmorrhage. Simple instruction in methods of dealing as far as possible with these conditions should be given to all men collecting the wounded.

Danger of Suffocation.—Danger of suffocation was most commonly due to loss of control of the tongue.

As a result of the injury, displacement of the tongue may occur to such a degree that the air passages may be obstructed. In this condition, posture was of vital importance and stretcher bearers should not lay the wounded man on his back but on his chest, with his head hanging downwards over the end of the stretcher. He should be kept in this position until passed into medical care.

If the wounded man can walk, he must stoop well forward till he comes under treatment.

We wish to emphasize the great importance of keeping the tongue well forward in these cases, and are of opinion that many lives might thus be saved by stretcher bearers and others.

Control of Hæmorrhage.—Correct posture will also tend to lessen hæmorrhage by keeping the tongue in the forward position, but it may be necessary to plug wounds external to the mouth, and also to apply digital pressure.

Regimental Aid Post and Advanced Dressing Station. — Beyond treatment for shock and hæmorrhage little can be done here, but the tongue should be kept in a forward position if necessary by a suture or clip. The throat should also be examined and cleared of foreign bodies.

Treatment at the Main Dressing Station and the Casualty Clearing Station.

The main dressing station is the first station at which the services of a dental officer are available for preliminary treatment of the jaws, but we consider it advisable to discuss together the treatment of cases at the main dressing station and the casualty clearing station, as the same principles would apply. It may easily be that the latter is the first station where efficient treatment can be given.

The following general principles are recommended after due attention had been given to shock, hæmorrhage and respiration.

Treatment by the Surgeon.

(*a*) *Approximation of Soft and Hard Tissues.*—Displaced hard and soft tissues should be corrected as nearly as possible to the normal position and fixed there at the earliest moment, but it is of the greatest importance that there should be no undue tension in the replaced soft tissues.

Where much bone is lost, the raw ends of bones should be covered by mucous membrane if practicable and the surgeon should also consider the advisability of sewing mucous membrane to the skin at the margins of the wound, if this can be done without tension. Catgut sutures are most suitable for this.

This suturing in the earliest stages is most important as it greatly reduces the extent and difficulty of later plastic procedure. Careful judgment is, however, essential in order to avoid the danger of over-approximation, especially in cases of large loss of tissue and particularly when the components of a mucous cavity, such as the mouth, nose and eye, are injured.

In the War, the after-treatment of many cases was rendered unduly difficult and prolonged by injudicious over-approximation of hard and soft tissues.

(*b*) *Drainage.* — Experience in the War having shown the high frequency of abscess formation which supervened in the lower jaw after these injuries, the surgeon should consider the advisability of providing submandibular drainage at the outset by the insertion of one or more tubes at the most likely sites.

Treatment by the Dental Officer.

There are two main principles :—

(i) The conservation of injured teeth and loose fragments of bone.

(ii) The fixation of displaced fragments of the jaw in correct position, as far as is possible at the time.

Conservation of Teeth and Fragments of Bone.—The decision for extraction of teeth rests with the dental officer and he should be most conservative in his outlook, bearing in mind the future treatment of the case and the probable importance of teeth in the retention of appliances. The exposed pulp of fractured teeth should be removed at once if possible when the teeth may be valuable in subsequent treatment.

As regards the controversial question of the extraction or retention of teeth on either side of the lines of fracture, there is a division of opinion, but it is agreed that at this early stage, at any rate, unless a tooth has actually been involved in the line of fracture, it should not usually be disturbed.

The retention of partly detached fragments of bone is a matter which concerns both surgeon and dental surgeon. The recuperative power of the fragments is usually good and as a rule none should be discarded. The slightest attachment of periosteum is sufficient justification for the retention of a fragment at this stage of treatment.

The Fixation of Displaced Fragments of the Jaw. (*a*) *The mandible* (*when teeth are present*).—As long as teeth are present in the fragments and in the corresponding region of the maxilla, the dental officer should immobilize the fragments in normal occlusion by inter-dental wiring, as far as is practicable and indicated at the time. This wiring is a comparatively simple measure under general anæsthetic, using the stainless steel or other wire supplied for the purpose. Even if the whole mental region is lost, the molar fragments should be held in normal occlusion by this means.

The following points should be kept in mind :—

(i) The throat should be well packed with one piece of a sufficient length of six inch roll gauze during intratracheal anæsthesia, until the jaws are ready to be wired together, when the packing should be removed.

(ii) If necessary a long stout stitch should be passed through the dorsum of the tongue and the ends secured. This stitch should not be removed when the operation is over, but left until the reflexes are fully recovered.

(iii) Owing to the extreme mobility of the fragments great care is necessary when manipulating the Mason's or other gag.

(iv) The mandible should be held forwards and upwards.

(*b*) *The Mandible* (*when Teeth are Absent*).—When the procedure above is not possible owing to the edentulous condition of the fragment or corre-

sponding maxillary region, fixation and control will be more difficult, and the dental officer will require to exercise resourcefulness and ingenuity.

The following measures may be possible :—

(i) If the patient is in possession of unbroken dentures, these might be utilized as splints assisted by external bandages.

(ii) Impression composition or gutta-percha might be moulded inside the mouth to control the fragments. It should be removable, well trimmed and of as little bulk as possible, and be held in by external strapping or bandage.

As a temporary measure in order to prevent adhesion between the cheek and the wounded area, Mr. Warwick James has used with success in some cases a piece of stout rubber tubing placed in the buccal sulci. The tubing should be about the diameter of a pencil and be long enough to extend the entire length of both sulci. When the ends are joined and it is in position, it forms a comfortable, smooth resilient support tending to keep the fragments in position. It has the advantage of being easily and rapidly made; it is quickly removed and replaced, and there is no danger of its being swallowed.

We consider that surgical wiring of fragments is absolutely contra-indicated in all compound fractures of the mandible.

(*c*) *The Maxilla.*—As a rule fractures of the upper jaw are more simple to deal with than those of the mandible. The fragments can be supported by the mandibular teeth with the aid of an external bandage. If the fracture is on one side only, the sound side can be wired to the mandible. If possible, it is better to arrange a support independent of the lower teeth, such as a modified Kingsley splint made of a shallow tray filled with impression composition (or gutta-percha), the extra-oral arms being firmly attached to a head bandage. (In this case the danger of any projection from the mouth during movement must be remembered.) A number of such trays, made into Kingsley splints, should be part of the standard equipment of the dental officer at the casualty clearing station.

Anæsthetic.—The preliminary treatment should in most cases be performed under general anæsthetic, the dental officer and surgeon working in co-operation and endeavouring to obtain adequate results at the one operation.

It is seldom necessary to perform tracheotomy.

Experience has shown that difficulties on account of vomiting after inter-maxillary wiring are extremely unlikely. Teeth would usually have been lost at the time of injury, or extracted prior to the wiring, thus allowing ample room for escape, but this consideration apart, we are agreed that possible suffocation from this cause should not give rise to concern.

X-ray.—Films of the jaws (R. and L., lateral and A.P.) should usually be obtained before operation if an X-ray plant is available, provided undue delay is not thereby entailed.

Bandaging.—The ordinary four-tail bandage should *not* be used, as it is

likely to increase the displacement of the fragments by its backward pressure.

Any bandage used should be so designed as to cause an upward and forward pressure well back from the chin. The "Barrel" and "Hamilton" types are very suitable and are easily and rapidly applied.

A useful external support is "elastoplast" or similar type of bandage, which is not quickly affected by soap and water and can be left for some days. A good grip can be obtained at the temporal areas and the scalp is left free.

Feeding.—The drinking cup with about three inches of free rubber tubing attached is the most suitable and convenient method of presenting liquid diet well back in the throat. It is worthy of remark that patients manage to swallow fairly well when fed in this manner, despite extensive injuries.

Mouth-washing.—A solution of sodium bicarbonate is specially recommended as a general routine in addition to the ordinary antiseptics. The mouth should be irrigated with the solution after meals by means of a Higginson syringe or by other suitable means.

Dressing of Wounds.—No special instructions are considered to be necessary as regards dressings, but owing to the constant dribbling of saliva in maxillo-facial injuries, these are rapidly soaked and require to be changed more frequently than in ordinary cases. A large jaconette or other waterproof bib should be constantly worn by the patient to protect his clothing.

Evacuation.—On evacuation from the casualty clearing station all cases should be ticketed with special labels designed to facilitate their direct transfer to the special jaw hospital or department of a general hospital allotted for their reception. Cases complicated by more serious injuries to other parts would not ordinarily be transferred to maxillo-facial hospitals and they should be ticketed as cases also requiring attention by the specialist surgeons (plastic and dental) attached to the general hospital to which they are sent. It would be most satisfactory if one general hospital could be earmarked for the reception of such cases.

In hospital ships, when the voyage is likely to exceed two or three days, facilities should exist for the dental officer to repair or remake immobilizing appliances.

Extra Dental Personnel.—We do not recommend any modification of the dental personnel at the main dressing station or the casualty clearing station.

Occasion may arise when it will be necessary to provide extra personnel or to reshuffle existing personnel, but this would depend on varied circumstances and would be purely a question of administration.

We recommend, however, that at least one dental mechanic be included in the establishment of a 600 bed general hospital.

REPORT ON DISEASES OF THE EAR, NOSE AND THROAT IN THE ARMY, WITH SPECIAL REFERENCE TO MIDDLE EAR SUPPURATION AS A CAUSE OF UNFITNESS FOR SERVICE.

BY DOUGLAS GUTHRIE, M.D., F.R.C.S.E.

Aural Specialist, Scottish Command.

As aural specialist to the Scottish Command for the past sixteen years I have had the opportunity of studying the diseases of the ear, nose and throat which are prevalent among the troops, of observing the incidence of the various diseases and of noting the effect of such diseases upon fitness for service.

It appears to me that a few notes on those matters may be of some value to those who are responsible for the general health of the Army and accordingly I submit the following report and commentary.

It would serve no useful purpose to include the years just after the War, when statistics were complicated by the inclusion of war injuries and of diseases directly due to active service. More valuable for the present purpose is a statement of the conditions obtaining in the Regular Army during recent years.

The report therefore is based upon the cases examined at the Military Hospital, Edinburgh Castle, from 1927-1935 inclusive, a period of nine years. During the period, 2,931 new patients were seen, an average of 325 per year. An examination of the records reveals the fact that two diseases, or rather groups of diseases, far outnumber all others in frequency. They are (1) tonsillitis, and (2) middle-ear suppuration (otitis media suppurative) as set forth in the following table :—

TABLE I.—INCIDENCE OF TONSILLITIS AND MIDDLE-EAR SUPPURATION IN SCOTTISH COMMAND, 1927-35.

	1927	1928	1929	1930	1931	1932	1933	1934	1935
Total new cases attending ear, nose and throat department	393	436	384	303	332	302	321	240	220
Tonsillitis	105	112	116	84	78	79	116	64	58
Middle-ear suppuration	112	137	117	79	113	96	69	50	49

(1) TONSILLITIS.

This disease is extremely common and is one of the principal causes of admission to hospital. Official reports on the Health of the entire Army for the past few years mention the figures stated in Table II.

TABLE II.—SOME PRINCIPAL CAUSES OF ADMISSION TO HOSPITAL, 1931-1934.

	1931	1932	1933	1934
Influenza	8,324	4,161	7,447	2,992
Malaria	7,191	5,765	6,365	4,272
Venereal disease	5,865	4,957	4,711	4,486
Inflammation of areolar tissue	5,261	5,421	5,603	5,585
Inflammation of nasopharynx (about 10th in order of frequency)	1,763	1,596	1,459	2,080
Inflammation of middle ear (about 20th in order of frequency)	752	748	739	737
Inflammation of tonsil	5,752 (4th in frequency)	5,307 (2nd in frequency)	5,674 (3rd in frequency)	6,021 (1st in frequency)

It is obvious from the above table that tonsillitis is one of the principal causes of inefficiency and of loss of working days. It is not a cause of permanent unfitness for service, and if the tonsils are competently removed by the dissection method the patient is permanently cured. The main indication for operation is a history of repeated attacks of tonsillitis. In order to test the efficiency of the treatment I ascertained the subsequent history of twenty-six men from one regiment (9th Lancers) who underwent operation in 1933. In no case had there been any further trouble with the throat.

Tonsillitis is probably commoner under Service conditions than in civilian life, and there appears to be no certain means of reducing its incidence. It is probably more frequent during and after epidemics of influenza. Fortunately we have, in tonsillectomy, a method of rendering the patient again perfectly fit for service.

Inflammation of the Nasopharynx.

Under this heading is included a large number of cases in each year, ranking about tenth in incidence as a cause of admission to hospital (*see* Table II).

The category is not altogether satisfactory as it must of necessity include such diseases as adenoiditis, rhinitis, pharyngitis, sinusitis and probably also nasal allergy. At all events the various forms of sinusitis, a common cause of inefficiency, should if possible be differentiated from inflammation of the nasopharynx, as the latter is in many cases a symptom rather than a disease.

(2) MIDDLE-EAR SUPPURATION (CLASSED AS INFLAMMATION OF THE MIDDLE EAR IN ARMY RECORDS).

This is another disease of great frequency. It ranks fairly low, about twentieth place, as a cause of admission to hospital (*see* Table II, in which, for the sake of simplicity, only a few "principal causes" have been mentioned). Nevertheless, a large proportion of the patients treated by the

aural specialist, one-fifth to one-third of total, suffer from inflammation or suppuration of the middle ear. The disease is a very frequent cause of inefficiency and ranks *second to tuberculosis as a cause of invaliding.* The figures for 1933 (Report on Health of Army) were 206 for pulmonary tuberculosis and 168 for inflammation of the middle ear.

In determining the question of fitness for military service, a distinction must be drawn between the recent acute case and the old-standing chronic case of otitis. This is not always easy, as the acute stage of otitis very gradually merges into the chronic stage. The period after which the acute case should be regarded as a chronic case is usually given as two to three months. Moreover a superimposed " acute exacerbation " of a chronic case may be difficult to distinguish from a simple acute otitis.

The acute cases form a varying proportion of the total, as may be gathered from the following table:—

TABLE III.—INCIDENCE OF MIDDLE-EAR SUPPURATION IN SCOTTISH COMMAND 1931-35, AND EFFECT ON FITNESS FOR SERVICE.

	1931	1932	1933	1934	1935
Total cases of middle ear suppuration	113	96	69	50	46
Acute suppurative otitis (practically all subsequently fit for service)	45	36	29	16	14
Chronic suppurative otitis	68	60	40	34	32
Number of chronic cases unfit for service	39	25	28	34	27

In the great majority of cases of acute otitis the prognosis is good. Under careful treatment, a discussion of which is outside the scope of this report, the ear returns to normal and hearing is restored. Very different is the case of chronic suppurative otitis. In the worst form one may find the meatus occluded by granulation tissue in the form of an aural polypus. Or there may be masses of white flaky material known as cholesteatoma. The patient may suffer from recurrent headache and attacks of giddiness. Sometimes the mere inconvenience of a profuse discharge is the only complaint. Any one of the above conditions constitutes grounds for invaliding, although a short course of conservative treatment should be tried as a rule.

Secondly, there is the case of chronic suppurative otitis in which the suppuration is no longer present and the ear is dry. The usual complaint is deafness and one may find an intact tympanic membrane showing the scar of a previous perforation. The question of fitness or otherwise will then depend upon the extent of the deafness, which is usually unlikely to improve under treatment. In other cases a dry perforation is present. If small it may be persuaded to heal under treatment, but more frequently it is large and there is often a slight discharge of which the patient is unaware. In assessing the question of fitness, length of service must be con-

sidered. While one does not hesitate to reject a recruit with a perforated drumhead, one might advise retention of a soldier who had already served for a period of years, provided he was fit for his present duty. All the evidence must be weighed, such as the degree of deafness, whether unilateral or bilateral, the amount and nature of the discharge, if any, and the medical history of this or any other disability. In my own experience I have found that the great majority of cases of chronic suppurative otitis or of its sequelæ (scars, perforations, deafness, etc.) are unfit for military service. Fortunately, owing to a greater care in the examination of recruits and more thorough treatment of cases of acute otitis, the disease now appears to be less common in the Army than formerly.

The problem of middle-ear suppuration in recruits calls for separate consideration. It is a matter of the utmost importance, as much time and money may be lost to the country by the acceptance and subsequent rejection of recruits as may very easily happen when middle-ear suppuration is overlooked. If any confirmation of this statement is required, it may be found in the accompanying table, which gives the three leading causes of rejection :—

TABLE IV.—PRINCIPAL CAUSES OF REJECTION OF RECRUITS ON ENLISTMENT OR WITHIN SIX MONTHS (1931-1934).

	1931	1932	1933	1934
Diseases of middle ear	3,680	3,057	3,175	2,464
Loss or decay of many teeth	2,260	2,460	2,764	2,162
Defects of lower extremities	2,509	2,402	2,494	1,702
Total number rejected ..	22,157	21,326	22,638	16,935

The above table shows that disease of the middle ear (usually of the nature of chronic suppurative otitis media or its sequelæ) is the principal cause of unfitness in recruits and accounts for the rejection of 50 to 60 recruits in every 1,000 who apply to enlist.

One might have given the smaller figures of the Scottish Command but they would form too small a basis for any conclusion and in any case the ratios correspond very closely to those of the entire Army.

The number of recruits examined each year is 50,000. Many are rejected at sight without being served with notice papers. Indeed, in the London Recruiting Zone in 1934, 67 per cent of the total were rejected for obvious physical defects. Of the remainder, provisionally accepted, 35 per cent were rejected on medical examination and the principal cause of rejection, as already stated, was disease of the middle ear.

It is of the utmost importance that in every recruit the ears should be carefully examined as to appearance and function. The tympanic membrane must be inspected by the electric otoscope after the removal of wax, if necessary, and the hearing for voice and whisper should be tested.

The hearing test is important, as certain diseases such as concussion deafness or otosclerosis may be present although the membrane is normal.

The presence of a perforation, even a dry perforation, should lead to rejection, as the perforated drum may be a gateway of reinfection under stress of Service conditions.

An intact tympanic membrane and good hearing should be regarded as essential to every candidate for military service. A clear unobstructed airway is hardly less important as many nasal abnormalities (enlarged turbinals, marked deviation of septum, etc.), imply a susceptibility to colds and consequent loss of working days.

In conclusion, I trust that this report, written with a view to emphasizing the importance of oto-laryngology in the Army, may be of some slight value to those who are responsible for the health and fitness of His Majesty's troops.

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LABORATORY METHODS—MEDIA MAKING: DETAILS OF TWO STANDARD BASES FOR THE PREPARATION OF DIFFERENT MEDIA.

By Captain A. SACHS, M.D., M.Sc.
Royal Army Medical Corps.

[Sent for publication December 21, 1935.]

The isolation of the more delicate types of bacteria requires the use of a large variety of special media, which unless stored in screw-capped bottles are liable to contamination and drying up, especially in the tropics. To keep these special media reduces the number of test tubes or other containers available for general use, and takes up valuable storage space. The circumstances in which these special media are required do not usually admit of delay, and in many instances the opportunity for their timely use will have passed if they are not immediately available. The media in general use are not adaptable for this special purpose, and the preparation of fresh special media involves too much time.

It would be a great advantage if some simple base or bases could be made from which the different media required could be rapidly prepared. In a previous communication (1929), a medium for the isolation of the gonococcus and other delicate organisms was described. During the past seven years this medium has been thoroughly tried out both in England and India, and its use extended.

A difference between these and other media is that the meat extract is first treated with a dilute alkali before use. A mild hydrolysis occurs and some undetermined change takes place among the constituents of the meat extract. It is this change which appears to give the media their nutritive value. Probably the change that occurs is in the nature of some chemical alteration, or possibly the destruction of some inhibiting substance.

Two bases have been devised: (*a*) *An alkaline hydrolysate of Lab-Lemco*; and (*b*) *an agar peptone base.* The detail of their preparation follows.

(A) Preparation of the Alkaline Hydrolysate of Lab-Lemco.

(1) Place 2 grammes of Lab-Lemco (*a*) in a sterile 500 cubic centimetre Erlenmeyer flask.

(2) Add 200 cubic centimetres distilled water and shake well until no large particles of the meat extract remain in suspension.

(3) Add 8 cubic centimetres N/1 NaOH and shake the mixture well.

(4) Place in an ice chest and leave overnight.

(5) On the following morning heat in a steamer at 100° C. for twenty minutes.

(6) Cool and replace in the ice chest overnight.

(7) Repeat this procedure on the following night.

The hydrolysate is now ready for use.

Note.—(*a*) Other meat extracts have been tried with indifferent success. Lab-Lemco is to be preferred as its composition is standardized.

(B) Preparation of the Agar Peptone Base.

(1) Place 12 grammes of finely-divided agar fibre (*a*) in a 500 cubic centimetre Erlenmeyer flask, and add 200 cubic centimetres of tap water.

(2) Melt the agar in a steamer—preferably under pressure. This requires about thirty minutes.

(3) While the agar is being melted, weigh out the following ingredients :—

Peptone (*b*)	12 grammes
Sodium chloride..	2 grammes
Disodium monohydrogen phosphate (Na_2HPO_4) ..	2 grammes
Glucose	0·4 gramme

(4) Add the above ingredients to the melted agar and shake well.

(5) Return to steamer and steam for twenty minutes. Then remove and allow to cool.

The agar peptone base is now ready for use.

Note.—(*a*) Agar fibre should be used as agar powder gave unsatisfactory results. (*b*) Witt's or Difco peptone gave the best results.

When the two bases have been prepared the different media can be made. These bases can be stored indefinitely.

The preparation of the under-mentioned media is detailed below :—

(I) A standard nutrient agar suitable for all routine work.

(II) A medium suitable for the isolation and cultivation of the gonococcus and pneumococcus.

(III) A medium suitable for the isolation and cultivation of the meningococcus.

(IV) A nutrient blood agar medium.

(V) A serum sugar medium for determining the fermentation reactions of bacteria.

(I) Preparation of a Standard Nutrient Agar.

Requirements:—

Agar peptone base	200 c.c.
Alkaline hydrolysate of Lab-Lemco	200 c.c.

Preparation :—

(1) Melt the agar base in a steamer. This takes from fifteen to twenty minutes.

(2) Steam the hydrolysate for five minutes.

(3) To the melted agar base add the prepared 200 cubic centimetres of hydrolysate.

(4) Shake well to mix.
(5) Tube off in test tubes in 5 to 10 cubic centimetres bulks as required.
(6) Steam these in a steamer for twenty minutes.
(7) Then remove and slope the tubes or pour plates if they are required.

This medium is now ready for use. Preliminary incubation for sterility can be carried out if so desired.

Notes.—(i) Provided the details of preparation are carried out as detailed above, the resultant reaction of the medium has always been found to be pH 7·3 to 7·4. (ii) Clearing the medium is not recommended. (iii) Should the necessity for ascertaining the reaction of the medium arise the following procedure is recommended: after mixing as detailed in (3) above, add 15 cubic centimetres of a 0·02 per cent. sterile solution of phenol red to the mixture and continue as before with the preparation. The final reaction of the medium can be checked against phenol red indicator tubes. The phenol red was not found inhibitory to bacteria.

(II) Preparation of a Medium Suitable for the Isolation and Cultivation of the Gonococcus and the Pneumococcus.

Requirements:—

Alkaline hydrolysate of Lab-Lemco	200 c.c.
Agar peptone base	200 c.c.
Human serum or plasma	10-15 c.c.

Note.—Plasma obtained from citrated human blood appeared to give better cultural results than human serum or plasma and serum obtained from animal blood.

Preparation:—

(1) to (6) Proceed as detailed above under (1) *Preparation of a standard nutrient agar*, but tubing off in 10 cubic centimetre bulks.
(7) After steaming remove the test tubes and allow them to cool until they can be handled with comfort. Then place in a water bath at 48° C. to prevent setting of the agar.
(8) To each tube add a $\frac{1}{4}$ to $\frac{1}{2}$ cubic centimetre plasma or serum and roll each tube between the hands to mix, and slope.

This medium is now ready for use. Incubate the tubes overnight for sterility, if time permits.

Note.—Phenol red can be used with advantage as the indicator and will act as a guide to subculturing. When the reaction of the medium alters, owing to the growth of the organisms, as shown by a change of colour, subculturing should be done. The indicator should be added as described in the note to the first medium mentioned above.

(III) Preparation of a Medium Suitable For the Isolation and Cultivation of the Meningococcus.

Requirements :—

Alkaline hydrolysate of Lab-Lemco	200 c.c.
Agar peptone base	200 c.c.
Sterile 0·02 per cent. of aqueous solution of phenol red ..	100 c.c.
N/1 NaOH	100 c.c.
Human serum or plasma	15 c.c.
A sterile 1 c.c. pipette.	

Preparation :—

(1) Melt the agar base in a steamer.
(2) Add 15 cubic centimetres of the sterile phenol red solution to the 200 cubic centimetres alkaline hydrolysate and then steam for 5 (five) minutes.
(3) To the melted agar base add the hydrolysate and indicator mixture.
(4) Shake well to mix.
(5) Add N/1 NaOH drop by drop from the one cubic centimetre pipette until the medium becomes a definite pink colour. The reaction will then be pH 7·6 to 7·8. This can be checked against phenol red indicator tubes.
(6) Tube off in 10 cubic centimetre bulks and continue as detailed above under (II) *Preparation of a Medium suitable for the Isolation and Cultivation of the Gonococcus and the Pneumococcus* No. (7) and onwards.

Note.—Although the reaction is estimated while the medium is hot, and is consequently lower when cool, it has been found that providing sufficient alkali has been added to give a definite pink colour, the resultant pH when cool is from 7·6 to 7·8.

This medium is now ready for use. Incubate the tubes overnight if time permits.

(IV) Preparation of a Nutrient Blood Agar Medium.

This may be prepared in the same way as detailed for the preparation of the medium for the gonococcus and the pneumococcus, but citrated or whole blood is used instead of plasma or serum. As an alternative method, tubes of standard nutrient agar can be melted, cooled to 48° C. and the blood then added.

(V) Preparation of a Serum Sugar Medium for Determining the Fermentation Reactions of Bacteria.

Requirements :—

Alkaline hydrolysate of Lab-Lemco	200 c.c.
Peptone solution (*a*)	200 c.c.
10 per cent solutions of the different sugars required (*b*) ..	5 c.c. of each
A suitable indicator (*c*)	50 c.c.

(*a*) *Preparation of the Peptone Solution* :—

Place the following ingredients in a 500 cubic centimetre Erlenmeyer flask :—

Peptone	6 grammes (Witt's or Difco peptone)
Sodium chloride	1 gramme
Distilled water	200 c.c.

Steam for 20 minutes. This solution is then ready for use.

(*b*) *Preparation of the Sugar Solutions* :—

The sugars generally used are glucose, lactose, maltose, lævulose, mannite and saccharose and, when needed, inulin. Place 0·5 gramme of each sugar and 5 cubic centimetres distilled water in a sterile 100 cubic centimetre flask. Place in a steamer until the sugars are completely dissolved. This takes about seven minutes.

(*c*) *The Indicator.*

The following indicators have been tried out :—

(i) Neutral red 0·5 per cent solution.

(ii) Phenol red 0·02 per cent solution.

(iii) Anrade's.

The neutral red and phenol red appeared to give the most satisfactory results.

Final Preparation of the Medium :—

(1) Mix 200 cubic centimetres alkaline hydrolysate with 200 cubic centimetres peptone solution.

(2) Adjust the reaction until pH is 7·4.

(3) Add 45 cubic centimetres of this adjusted mixture to each 100 cubic centimetre flask, which contains 5 cubic centimetres sugar solution. (The number of flasks used will depend on the number of sugars.)

(4) Tube off in 2 cubic centimetre bulks in small test tubes. Care should be taken to ensure that the different sugars are correctly labelled.

(5) Sterilize the medium by steaming in a steamer for twenty minutes on three consecutive days.

(6) After the third steaming allow the medium to cool, and then add two drops of serum or plasma to each tube.

The medium is now ready for use. Incubate overnight for sterility.

Procedure.—Each series of tubes is inoculated with the organism to be investigated and then incubated for forty-eight hours. A series of uninoculated tubes is used as a control and treated in the same way as the others.

After incubation 0·25 cubic centimetre of indicator is added to each tube, which is then well shaken and returned to the incubator for thirty minutes. Both inoculated and uninoculated tubes are then examined and any alteration of colour noted, acid production denoting fermentation.

Note.—It was found that by adding the indicator after incubation of

the cultures, more clear-cut results were obtained. It is advisable to test out every fresh supply of saccharose with known fermenters and non-fermenters, as false fermentation results have been obtained from some batches of the sugar.

Employment of the Media.—The medium for the isolation of the meningococci was used extensively in 1931 when investigating an outbreak of cerebrospinal meningitis at Nasirabad in India. All isolations from cases and carriers were made on this particular medium. The fermentation results of all likely organisms were carried out on the serum sugar medium described above.

Eight strains of meningococci were brought to England for further investigation. A bulk supply of the medium without the addition of any serum was taken. This was melted as required and the necessary serum added to each tube. It was found that although the main bulk was remelted eight times, there was no appreciable diminution in the cultural value of the medium. Alteration in the reaction was taken as the only guide for subculturing. The majority of the strains kept alive without subculturing for four to five days.

This medium was again used when investigating cases of meningitis in Aldershot. Positive cultures were obtained when peaflour agar was negative.

The other media have been employed as required and have given results which compare very favourably with other similar media in use.

Screw capped bottles of various sizes have been used with advantage in lieu of flasks.

Summary.

The preparation of the following media has been described :—

(I) A standard nutrient agar suitable for all routine work.

(II) A medium suitable for the isolation and cultivation of the gonococcus and the pneumococcus.

(III) A medium suitable for the isolation and cultivation of the meningococcus.

(IV) A nutrient blood agar medium.

(V) A serum sugar medium for determing the fermentation reactions of bacteria.

These media have the following advantages :—

(1) They can all be prepared from two bases.

(2) The preparation of these two bases is simple.

(3) They can be stored indefinitely.

Reference.

Sachs, A. (1929). Journal of the Royal Army Medical Corps (June), 452.

ROYAL SOCIETY OF MEDICINE UNITED SERVICES SECTION WITH SECTION OF PSYCHIATRY.

DISCUSSION ON FUNCTIONAL NERVOUS DISEASE IN THE FIGHTING SERVICES.[1]

Colonel J. Heatly-Spencer: When the Great War broke out in 1914 functional nervous disease in the Services was not met with frequently nor was it at all well understood. Among the civil population at this period clinics for these cases were very few and were connected with the then fashionable cult of "psychology" which was being exploited in the drawing-rooms of well-meaning but erratic people who liked to pose as "psychics," whatever that term may imply. In other words, the subject of psychotherapy was fighting a battle for two ends: (1) To rid itself of the charge of charlatanism which had become attached to it through the interference of unbalanced lay persons who try to exploit anything new. (2) To win recognition in this country from the orthodox profession as a measure of real therapeutic value.

That was the position when the War came upon us.

I would like here to refer to the sound prevision of a very able worker in functional nervous disease—Dr. Maurice Wright—for I had the privilege of being associated with him in the initiation of a movement which led to the proper organization, classification, and treatment of these cases among officers. Dr. Wright foresaw the occurrence of a great many cases of nervous breakdown owing to the strain of war, and we had many discussions upon the topic. As a result of his foresight the active sympathy of the then leading neurologists in London was obtained, and then the scheme for having special hospitals for the treatment of such cases was laid before the late Lord Knutsford. I need not say more than that once his organizing genius had been brought into action, the movement went forward to a great success, and resulted finally in the whole group of functional and organic nervous and mental diseases among officers being taken over by the five hospitals which were opened under the Knutsford Scheme—a scheme officially approved by the War Office. The position as regards officers was satisfactory by the end of 1915. What of the other ranks? I have no available figures for 1915, but during 1916 the numbers of functional nervous casualties had risen to 8,700 for the year. What were the conditions under which these men were being dealt with? I can only speak of what they were like in the 1st Army Area, for in the War we were all in our own "compartments" and could not know what went on a few miles north or south of us. I will give an example of a certain "shell-shock and neurasthenia" treatment centre in France. One day a very good medical officer came to me and said, "I have to take over the shell-shock centre at ——; tell me, how do you hypnotize people?" Now near the centre was a trench mortar school and a machine-gun school. On one historic occasion German 15-in. shells were stirring things up at least three miles behind it. Picture the effect upon some shell-shocked

[1] Reprinted from the *Proceedings of the Royal Society of Medicine*, vol. xxix, p. 855, by kind permission of the Honorary Secretaries.

soldier produced by the appalling concussion of one of these shells, to which was added the rattle of machine guns and the bursting of trench mortars. The position was very unsatisfactory but, again owing to representations made by Lord Knutsford, the whole of the arrangements were then reorganized under the able direction of Dr. Gordon Holmes, and from that time one may say that these functional cases received proper recognition and adequate classification and treatment—with great improvement in the results obtained. The position as regards other ranks was satisfactory by the autumn of 1916.

That is briefly the history of the functional nervous group in the early years of the War.

I would like now to draw your attention to the basic factor of fundamental importance in the genesis of this group of cases. Here are the figures for the years 1916 to 1920. In these years, out of 1,043,000 casualties (excluding gun-shot wounds) there were 21,500 cases of functional nervous disease, i.e. 2%. Their yearly incidence is illuminating :—

Active operations			Armistice	
1916	1917	1918	1919	1920
8,700	5,900	5,100	1,404	357

Note that gas casualties were rising fast all the time up to 1918.

There is no sustained drop in the figures until the guns ceased to fire, then there is this huge drop of 75% in the year after the cease fire, and the figures became almost negligible in 1920—affected, of course, to some extent by demobilization.

There is no getting away from such figures, and that is why it becomes so difficult to discuss this question in peace conditions. It is essentially a war-produced group and caused not by discomfort and privation, but by the fear, either conscious or unconscious, of physical danger in the individual. I think this fundamental fact of fear is one never to be lost sight of. It is no disgrace for any man to be afraid—the only disgrace arises when in front of his fellows he ceases to control that fear adequately and it becomes openly reflected in his actions. There is thus, as in mental conduct in general, a boundary line beyond which the conduct of the individual must not be openly expressed—in the one case it is what we call insanity, in the other cowardice. I do not think we have anything to do with openly expressed fear—otherwise cowardice. We find our work in dealing with the multiple expressions of defence against this open avowal of fear which arise either suddenly, as an hysterical splitting of the consciousness, or as the gradual development of a nerve exhaustion reflected in the physical well-being. I think possibly much grave harm is done by holding in front of the individual the idea that to feel fear is a sign of cowardice—no more mistaken idea could possibly arise. To feel fear is not cowardice, to allow it to master the actions is. It seems to me that attempts to force the good effects of *esprit de corps*, patriotism, or whatever particular term is employed to express the idea, are often undoing their own avowed purpose, for they are inclined to teach a man that unless he *feels* brave and can conscientiously swagger in the face of danger he is at heart a coward. Such a teaching, instead of binding him to his mates by a sense of comradeship and understanding, merely convinces him that he is unworthy and drives him into a series of mental conflicts that are an agony to his peace of mind and pave the way for nervous breakdown.

What we should teach, if we teach anything, is that to feel fear in the face of danger is the natural heritage of every conscious living organism, man or animal, and that by controlling it every man becomes at heart a hero, and the comrade of the men on his right and left who have the very same feelings as his own. The whole process of this self-reproach, mental preoccupation, and morbid introspection is admirably portrayed in the classical play "Journey's End," in which are seen all degrees of self-adjustment to a basic fear—from the perfect control of the admirable serjeant-major to the studied and artificial indifference of the schoolmaster, and finally the imperfect control of the hero who has to take alcohol to enable him to carry on at all. In this last case it was not a question of not wanting to be brave, but one of inhibitions, and he tried to drown these in alcohol.

One saw the same thing at first hand. I was for some time in medical charge of an artillery observation squadron of the then R.F.C. Pilots used to come to me in confidence and say, "Doc., I feel I am cracking—I have literally to fight myself to take off in the morning—what am I to do?" Their main fear was that it might be noticed by their comrades. I used to tell the Wing-Commander that the officer in question had had some diarrhœa and stomach trouble and that a change of diet on leave would do him good. He understood. Such men would never have consented to go into a hospital for nervous disease—it would have ruined their faith in themselves. Later on I well remember in Macedonia the manner in which some men suffering from neurasthenia were looked upon. "'Nerves'? No such thing in the British Army!"

As regards the different types of individual we have to deal with—it takes all sorts to make a world and you will find the world well represented in any fighting force. I may mention three widely differing types which roughly cover the ground of individual differences in such a force. First there is the phlegmatic type—the "natural fool," often of low intelligence, and unimaginative, whose interests are mainly directed towards the cook-house. Such men, if temporarily knocked out of their accustomed sang-froid by a concussion or other event outside their normal experience, will often respond satisfactorily to the attentions of the knockabout hypnotist. Given an operator of sufficiently forbidding aspect, such men can be stood against a wall, sent to sleep, put through a variety of contortions and commanded to wake up and go out and win a V.C.; sometimes they do make good. Their cure has the fatal defect that it is based not on their own inward strength but upon some supernatural quality in the mind, or it may be even in the face, of the operator.

The next type is the commonest—the ordinary decent fellow who is imaginative, and often highly educated in one particular line; with this type I do not think knockabout methods ever produce much success. To build up the self-confidence of these men is a very difficult matter, for they can only be guided, and must work out their own salvation by gradually increasing accomplishment. In these cases the experience, psychological knowledge, and tact of the doctor must be great, for often some loosely phrased sentence will throw them back and cause the basis of success—confidence in their doctor—to be destroyed.

The last type is really pathological and should find no place in any fighting force. I mean the highly strung, highly imaginative individual, with an unstable nervous

system based upon some inherited bodily defect. In the Army we cannot always prevent the enlistment of such men, but undoubtedly it ought to be prevented, as I understand it is in the Royal Air Force.

With regard to the legacies of functional conditions left us by the Great War, I need only remind you of the views of so able and experienced an observer as Dr. Mapother who has a vast experience of these cases. We have at the present time a common complaint among senior officers—anxiety neurosis. No doubt this is due in part to the disciplinary system in the fighting services. We live in an age of increasing efficiency coupled with annual confidential reports. The struggle to remain efficient with advancing years—to lift himself out of the common lot into the zone where special promotion may mean so much to his family—the fear of an adverse report which may undo efforts of a lifetime—all these things combine to produce strain and anxiety in the senior officer of to-day. Does it confine itself to the mental field? Are we sure that the large number of such officers who present arterial degeneration and some degree of consequent myocardial disease are not reaping the results of a strain which originated in the War and has become perpetuated by the stress of modern conditions?

We are faced then with the probability in the event of another big war, with perhaps 1 or 2% of medical casualties among individuals who for various reasons cannot adapt themselves to the adequate control or sublimation of a naturally felt fear. How they are to be treated is a problem for this discussion. One thing is certain—that the advent of another war will find us prepared for such cases and ready with at least some ideas as to how the problems are to be faced.

I wish to stress one last point. I do not believe that any good can result from the over-preaching of virtue to the soldier. If we try to do this, whether by the knockabout methods of the serjeant-major or by a moral exhortation, to a man who is already perhaps feeling a somewhat natural degree of fear and if we say to that man "you, as a soldier and a British subject, have no right to feel any fear at all," we shall not make him any less afraid, but will start ideas in his mind that he must be an unworthy soldier. We shall certainly start a process of introspection, and introspection, as every psychologist knows, is the sure and short way to perdition. If anything at all is to be said on this subject it is this: The harmful emotions that become bottled up in a man's mind can be got rid of most successfully by his keeping his thoughts turned away from himself—by directing him to anything outside himself—to his job, to his superiors, and in particular to the cultivation of a spirit of real comradeship with the man on either side of him. It is by these means alone that each of us can come to maintain some degree of mental peace in the face of danger.

(*To be continued.*)

Clinical and other Notes.

THE USE OF THE ELASTIC ADHESIVE DRESSING (ELASTOPLAST) DURING ANNUAL TRAINING IN CAMP.

By THE MEDICAL OFFICERS OF THE 51ST (HIGHLAND) DIVISION.
EDITED BY LIEUTENANT-COLONEL J. KINNEAR,
Royal Army Medical Corps (T.A.).

THE use of the elastic adhesive bandage (Elastoplast) in the treatment of varicose ulcers has been widely known for some years but its usefulness in the treatment of many other conditions is probably not fully appreciated. Experience with this type of dressing in hospital and private practice led me to realize its peculiar advantages for military purposes and, accordingly, it was arranged to try it out on a somewhat large scale during the annual training in camp of the various units of the Highland Division. The medical officers of the units concerned combined to furnish reports and suggestions as to its future use and an ample supply of Elastoplast bandages was kindly put at our disposal by the makers for the purposes of this test.

The main test we wished to make was the efficiency of this dressing on broken skin, whether infected or not, and its advantages in helping to keep men fit for duty or shorten the period off duty. The advantage of simplicity is obvious. No lotions or cumbrous dressings are required, strict attention to asepsis is not necessary. Elastoplast is simple to apply, light, and small in bulk.

The use of this dressing on septic lesions is perhaps against one's medical teaching and, personally, when I first used it I had considerable qualms as to what might happen underneath when it was left undisturbed for several days, but such fears proved groundless even in extensive infection of the scalp [1]. Others have had similar experiences in the treatment of impetigo [2], cellulitis and other septic conditions [3] and even in the treatment of severe mutilated wounds [4]. The use of Elastoplast for the treatment of boils [5] is probably now widely adopted.

For clean injuries this dressing seems equally suitable. For burns it can be used at any stage and with any degree of severity [3]; I have personal experience of its value both in burns and friction blisters.

It has also been found useful in various types of fracture and in sprains, though these cases were kept apart in the present investigation as not including broken skin and requiring, as a rule, considerably more dressing.

Possible disadvantages were :—

(1) *Sensitization.*—Certain skins are sensitive to the chemicals incorporated in this bandage as some are to ordinary strapping, but in my experience this is only a minute percentage, especially when only a small area of skin is covered. No cases of this kind arose during the present investigation.

(2) *Sepsis occurring under the bandage.*—This is occasionally found and the reason is not obvious, as sepsis usually disappears with its use. Only one case of this kind occurred in the present series when a bandage removed on the eighth day from a sprained knee disclosed a superficial inflammation behind the knee which cleared up in a few days. The sprain had benefited by the bandage. Mechanical irritation due to movement was probably a factor in producing this inflammation.

(3) *Difficulty in removal,* especially from a hair-bearing area of the skin. Where this is likely to be experienced the part may be shaved before application of the bandage, but the use of an organic solvent such as carbon tetrachloride, which is more efficient than alcohol or ether, helps in the removal. Removal from septic lesions is usually easy as a film of serum or pus prevents the bandage adhering to the actual wound, and the infrequent change of dressings required compared with more ordinary applications is of importance both to the medical staff and patient.

The small amount of bandage and the fewer number of dressings required make this method economical as well as saving of time and man power.

Result of Test.

Two 3 inch Elastoplast bandages were issued to the officer in medical charge of each unit, along with a pro-forma designed to give as much information as possible, consistent with simplicity.

The information we attempted to gather was :—

(1) The types of lesion dealt with and the result of the treatment.

(2) The number and frequency of dressings required.

(3) The amount of duty for which each man was fit while under treatment.

(4) The amount of this dressing used during camp.

(5) The amount of other dressings used during camp, in order to elicit any saving of material by this method of treatment. It is however doubtful if any definite conclusion can be drawn from the information obtained regarding this point.

The following suggestions for using the dressing were also issued :—

> "This dressing can be used for such lesions as blistered heels, boils, septic fingers, etc., wounds of all kinds such as are likely to be encountered in camp, burns of any extent or severity. No hesitation need be felt in covering a septic wound even if lymphangitis is present. In this case the bandage should be extended to cover the lymphangitis. It is not considered necessary to cleanse thoroughly the lesion prior to application of Elastoplast, but if very dirty it may be swabbed with methylated spirit. This may be repeated when the dressing is changed. Iodine should not be used. Once applied the dressing should be allowed to remain *in situ* as long as possible ; this varies from two to three days in the case of blistered heels, etc., up to three weeks or so in the case of burns. Where blisters are present they may be incised but there is no need to clip away all loose skin."

Reports were received from fourteen units. Two units used no Elastoplast and no pro-formas were returned from a further two units but the medical officers concerned reported that they had used this dressing and approved of it.

From the remaining units thirty-nine cases were reported.

Analysis of the returns shows that the following lesions were treated by this method.

(1) Blistered feet: 19 cases. Fourteen had only one application of Elastoplast and of these 9 remained fit for duty, 4 had one day's light duty and 1 three days' light duty. The blisters in this last case were infected. One man had two applications of Elastoplast on the first and second days and one on the first and fourth days; both remained fit for duty. One man with septic blisters had three applications on the first, third and sixth days but remained fit for duty. One man had daily applications of Elastoplast for five days and four days light duty.

In the Field Ambulance the following procedure was adopted after a route march. The men's feet were inspected immediately after the march by the orderly medical officer who had an Elastoplast bandage and a pair of scissors. If he discovered any blister or signs of abrasion of the skin, he cut off the requisite amount of dressing and applied it straight away. The man was told to report sick if the foot troubled him and to allow the dressing to remain in place as long as possible. Though it is preferable that the feet should be washed before inspection this was not found necessary for success with the method and the feet could be washed in cold water after the dressing had been applied without disturbing it. This routine was found very satisfactory.

Abrasions knee: 1 case; 1 dressing, fit for duty.

Abrasions heel and knee: 1 case; 1 dressing, fit for duty.

Septic hands or fingers: 4 cases; 3 dressed first and third days, 1 first, third and fifth days; all remained fit for duty.

Septic arms or legs: 4 cases; 1 dressed first and third days, 1 first and fifth days, 1 first, third and fifth days; all remained fit for duty. One case dressed first and third days had five days light duty.

Lymphangitis: 1 case, dressed first and third days and incised. He was given one day excused duty.

Boils—head and neck: 4 cases; 1 dressed first and second days, 1 first and fourth days, 2 first and fifth days. All remained fit for duty. Body: 1 case, dressed first and third days, fit for duty. Arms: 4 cases; 2 dressed first day, 1 first, third and fifth days, remained fit for duty. One dressed first day had one day excused duty and two days light duty. Legs: 3 cases, 1 dressed first day, 1 first and third and 1 first and fifth day. All remained fit for duty.

Cut fingers and hand: 3 cases, each one dressing. Fit for duty.

Cut eyebrow: 1 case, 1 dressing. Fit for duty.

Insect bite, face: 1 case, dressings first and third days. Fit for duty.

Spiked heel: 1 case, dressed first, fourth and eighth days. Seven days light duty.

Contused finger: 1 case. Dressed first, third and fourth days. Fit for duty.

Contused wound forehead : 1 case ; 1 dressing, fit for duty.

Torn arm : 1 case ; 1 dressing, fit for duty.

Sprained knees : 3 cases ; 2 had three days light duty ; 1 excused duty.

Sprained ankle and foot : 2 cases ; 1 full duty, 1 light duty.

Weak knee : 1 case : full duty.

Fractured metacarpal ; 1 case ; four days' light duty.

No cases of burns were reported.

Conclusions.

This analysis, though it is of necessity brief, shows, I think, that this method of treating such conditions is effective and simple to use. No medical officer reported against its use. One thought that inability to observe how a septic lesion was progressing under the dressing was a disadvantage, but experience shows that this is not so. One case of sprained knee (mentioned previously) showed that in the flexure of a joint movement may cause mechanical irritation of the skin and this appears to be a point worth noting.

The explanation of the beneficial results of this form of treatment is not obvious, but must largely lie in the protection and support given to the damaged tissues. Two factors are of importance to obtain the best results. First the dressing should extend for some distance beyond the margins of the lesion, and, secondly, the bandage must be in contact with the lesion, the interposition of some dressing such as plain or medicated gauze appears to interfere with the process of healing and is definitely a disadvantage.

If these two factors are observed in applying the dressing, the patient will experience an immediate sensation of relief, the blister, boil, burn or other wound is less painful because it is protected and supported, further injury is avoided and the *vix medicatrix naturæ* allowed to act under more or less ideal conditions.

I have to thank Colonel J. Taylor, A.D.M.S., 51st (H) Division, for permission to carry out this test and for his encouragement, and Messrs. T. J. Smith and Nephew, Ltd., Neptune Street, Hull, for the readiness with which they put an ample supply of Elastoplast at our disposal for the purposes of this test.

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ISOLATION OF *BACTERIUM TYPHOSUM* FROM PLEURAL EFFUSION AND SPUTUM IN A CASE OF TYPHOID FEVER.

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THE case to be described possesses some unusual features which are considered worthy of record.

Serjeant H. was admitted to the British Military Hospital, Quetta, on October 1, 1935. The history, given by the patient himself, was that he had not felt well for about a week prior to admission, and that during this period he had suffered from headaches, repeated rigors with sweating, and a feeling of malaise.

On admission the evening temperature was 103·8° F., and physical examination revealed that the spleen was palpable and was half an inch below the costal margin. The tongue was moist and coated, but nothing abnormal was found in the other systems. Blood-films were examined on five occasions and no malaria parasites were found. Blood-culture for malaria was also negative, as was a blood-culture for organisms of the enteric group taken on the third day after admission. Blood-culture for this group of organisms was subsequently repeated on three occasions with negative results.

A white blood-count taken on the fifth day after admission indicated a leucopenia, i.e. 4,800, but there was no relative lymphocytosis.

The case was considered to be clinically one of the enteric group, and this was supported in some degree by the rise in agglutinins found in the Widal tests. Apart from fever and persistent headache there was nothing of note in the patient's condition.

On the ninth, tenth, and eleventh days after admission, *Bacillus coli* was isolated from the urine. The patient was placed on an alkaline diuretic mixture three times a day, and subsequent cultures of the urine were negative.

The patient's condition remained unaltered apart from a tendency for the temperature to assume a lower level. Headache was the only troublesome feature.

On October 14, which was considered to be the twenty-first day of the disease, *Bact. typhosum* was isolated from the stools. The isolation of this organism in conjunction with the clinical picture established the diagnosis as typhoid fever.

On the following day the temperature reached normal and the general condition of the patient was quite satisfactory. Two days later, however,

the temperature rose to 103·6° F. A relapse was suspected and blood for culture of enteric organisms was taken. This blood-culture was negative.

A few days later the patient developed pain on the right side on deep respiration with slight cough and increase of liver dullness upwards posteriorly. Signs of a bilateral patchy bronchopneumonia more marked on the right than on the left side developed. Signs of a pleuritic effusion developed subsequently and exploratory puncture of the right pleural cavity was carried out. This yielded about three cubic centimetres of serous fluid which was slightly blood-stained. This fluid was sent to the District Laboratory for examination and was cultured on agar and blood-agar. A Gram-negative bacillus which, on further investigation, proved to be *Bact. typhosum* was grown on both media. In view of this result, which was, quite frankly, unexpected, and as the patient was coughing up a small amount of purulent sputum which was blood-stained, culture of the sputum was carried out daily. In the first instance the sputum was plated direct on litmus lactose bile salt agar, and also on the same medium after passing the sputum through 1 : 200,000 brilliant green. Direct plating yielded one colony of *Bact. typhosum* in addition to staphylococci, while plating after passing through brilliant green resulted in a luxurious growth of *Bact. typhosum* in pure culture.

Up to the moment of writing this note (February 1, 1936) *Bact. typhosum* has been isolated from the sputum on twenty-four occasions out of forty specimens examined by the brilliant green method. Recent specimens have on occasion given a pure culture of the organism by direct plating, as well as by the brilliant green method. As a precautionary measure the orderlies wear gauze masks in attending to him. The question of droplet infection was investigated by making the patient cough at a L.L.B.S.A. plate held two feet away on several occasions. *Bact. typhosum* was not cultured on any of these occasions. Actually, we have observed that the organism is only cultured when the specimen is definitely purulent.

The patient is now convalescent and his condition is quite satisfactory, apart from slight cough and scanty sputum.

A summary of the laboratory findings is appended for ready reference.

(1) Examination of films for malaria—five on 1·10 and 2·10: result negative.

(2) Blood-cultures.

Date	3.10.35	7.10.35	17.10.35	25.10.35
Day of disease ..	10th	14th	24th	32nd
Result	Neg.	Neg.	Neg.	Neg.

(3) Blood-culture for malaria parasites, 2.10.35 : result negative.

(4) White blood-counts :—

October 2, 1935 : Total, 4,800. Neutrophil polymorphs, 72 per cent ; lymphocytes, 26 per cent ; large mononuclears, 2 per cent.

November 8: Total, 11,700. Neutrophil polymorphs, 85 per cent ;

lymphocytes, 13 per cent ; eosinophils, 1 per cent ; large mononuclears, 1 per cent.

(5) Culture of fæces :—

Date	14.10.35
Day of disease ..	21st
Result	*Bact. typhosum* isolated

(6) Agglutination tests :—

Date	5.10.35.	7.10.35	10.10.35	15.10.35
Day of disease ..	12th	14th	17th	22nd
Result—T. ..	25	50	50	50
A. ..	50	125	125	125
B. ..	125	125	50	50
TO. ..	—	—	50	50

(7) Culture of pleural fluid :—

Date	9.11.35
Day of disease ..	48th
Result	*Bact. typhosum* isolated

(8) Culture of sputum : *Bact. typhosum* isolated on November 13, 1935 (fifty-second day of disease), and on twenty-three subsequent occasions out of forty specimens examined. The brilliant green method mentioned above was used.

Culture on blood-agar showed the presence of *Bact. typhosum* on occasions and also staphylococci and streptococci in short chains.

Discussion.

The points of interest in this case are :—

(1) The development of a *B. coli* bacilluria during the third week of illness. We suggest that this may have been due to a blood infection via the typhoid ulceration of the gut.

(2) The isolation of *Bact. typhosum* from the pleural effusion. We have not found a record of a similar isolation in the medical literature available in Quetta.

(3) The ease with which a profuse growth of *Bact. typhosum* in pure culture was isolated on twenty-four occasions from the sputum after passage through brilliant green. It is suggested that this method might be used with advantage in examining sputum for organisms in cases of bronchopneumonia of doubtful origin. By its use difficult cases of enteric fever might be diagnosed.

(4) The fact that the patient was a " lung carrier " during convalescence. We have mentioned in the text, however, that the organism was only isolated from sputum which was definitely purulent, and that isolation from L.L.B.S.A. plates at which the patient had coughed failed.

Our thanks are due to Lieutenant-Colonel W. L. Webster, Officer Commanding, British Military Hospital, Quetta, and to Colonel J. B. Grogan, A.D.M.S., Baluchistan District, for permission to forward this note for publication.

Echoes of the Past.

WAR EXPERIENCES OF A TERRITORIAL MEDICAL OFFICER.

By Major-General Sir RICHARD LUCE, K.C.M.G., C.B., M.B., F.R.C.S.

(*Continued from p.* 412, *vol.* lxvi.)

Chapter VIII.—Autumn Discomforts.

Though no further serious effort was made to force the Turks out of their position on the hills, the autumn months were not wasted in idleness. The troops were constantly occupied to the full extent of their strength in improving their trenches and pushing them forward towards the Turkish lines, which at first were in some places as much as five to six hundred yards from our own. In this way a considerable amount of ground was gradually gained to the right of Chocolate Hill, the ground on which the 11th Division, as well as our own Division, had had such heavy losses on August 21, and which we found still strewn with large numbers of our dead whom it had not been possible to bury previously.

In addition to this work much was done to provide trenches for the supports and reserves on the plain between Chocolate Hill and Lala Baba. A strong second line of defence was made, also, halfway across the plain, and a third on Lala Baba itself, in order to be able to cover an embarkation should it at any time become impossible to hold our existing line.

A regular system of communication trenches between the reserve and front line trenches formed part of the scheme. When this was accomplished it was no longer necessary in our daily visits to the trenches to walk for a mile and a half in full view of the Turks, who rarely failed to pay heed when two or three were gathered together. It was early realized that the position of the troops would be very uncomfortable in bad weather, and careful schemes were worked out for improving their quarters by the provision of bath houses, drying rooms, kitchens, etc., in the trenches, all of which, had they been carried out, would have involved the provision of a good deal of engineering stores, such as roofing material, which did not show much signs of arriving. But it was not, perhaps, sufficiently foreseen that many of the trench works that we had made in our divisional area would be untenable after heavy rain, owing to their low-lying position.

Passing through the gap in the hills to the right of our line and between us and the Anzacs, was the dry bed of a stream known as the Azmak Dere, which had considerable potentialities for producing a flood after a heavy

storm; our trenches crossed it and communicated with it in many places.

On the evening of November 26, there was a very heavy thunderstorm. The Azmak Dere quickly came down in spate. It burst the barriers which had been put up between ourselves and the Turks, and soon overflowed its bed. The water, unable to make its way fast enough to the sea, poured out along the trenches and flooded the whole system over a considerable area. The flood came in the night and caught the troops unawares. They managed to scramble out of the trenches themselves, but their kit and stores were largely submerged and lost. The soil was soft and sandy, the walls of the trenches fell in and buried everything in mud and water.

Next day the rain turned to sleet and the temperature went down to freezing point with a bitter north-east wind off the hills. The condition of the men was pitiable. Wet through to the skin, without shelter or change of kit, standing up to their knees or higher in icy cold water, which they could not leave without exposing themselves to full view of such of the enemy as were themselves in a condition to observe them, and with little possibility of cooking anything to warm themselves, they were chilled to the bone and became exhausted. Their legs and feet, exposed continuously to cold water, were rapidly undergoing those changes which result in the paralysing and subsequently maiming condition known as trench feet, a condition which shows every gradation between severe chilblains and actual frostbite gangrene. The men in the front line stuck gallantly to their posts; on the right was the Highland Brigade—men of wonderful physique and endurance, enured to climatic hardships from childhood; the Scottish Horse on the left did not suffer quite so much, as they were generally on higher ground. In our own Division there was no failure of discipline. The men stuck it out for more than sixty hours, but the number that continually had to go sick was enormous. During the week from November 27 to December 3, 44 officers and 1,539 other ranks, out of an average strength of 4,336, i.e. 34·9 per cent, were admitted to hospital, more than one-third of our whole strength, and of these, 43 officers and 1,153 other ranks had to be evacuated from the Peninsula by hospital ship. This does not include the casualties of the brigade of the 53rd Division attached to us which were equally heavy.

Fortunately we had no death immediately traceable to exposure, though some of the other divisions had many from pure exhaustion.

The bitter north wind and sleet continued all through the 27th, 28th and 29th. The troops in the reserve trenches were collected together as soon as possible into some of the drier areas, but during the first rush of the flood they had suffered badly, especially the brigade of the 53rd Division attached to us. Eighteen per cent of our admission cases were for trench feet, twenty-seven per cent for shock from exposure and twenty-five per cent for rheumatism.

Most of the foot trouble did not show much at the time, but the subsequent results were in many cases very serious. Several secondary cases of tetanus occurred and many subsequent amputations had to be performed for gangrene, some of which were double. The rheumatism was mostly muscular, slow in developing and slow in clearing up. The shock cases for the most part improved rapidly with warmth, dry clothing and hot food.

The Turks were in no position to take advantage of our discomfiture for their condition was as bad as our own. Large numbers of them bolted to the hills, others were shot sitting on the edges of their trenches.

There was, apparently, a movement to surrender on the part of quite a number at one point on the extreme right of our line, but they were fired on by the Gurkhas on our right who did not understand the movement and the Turks were seen flying back up the hills from their trenches on the low ground.

It will be readily understood that there was a tremendous strain thrown on the medical services.

Early in September it had been realized by those on the spot that there was not sufficient accommodation for patients on the Peninsula if a spell of bad weather should interfere with the regular evacuation from the Casualty Clearing Stations to the hospital ships. Urgent representations were made of the need for increased accommodation in the field ambulances; hospital marquees were asked for but never came. Then an effort was made to get shelters built in which patients could be housed temporarily. The engineers had the greatest difficulty in obtaining the wherewithal to make these but at last a certain amount of timber was provided and some more was available from wreckage washed up on the beach, but no proper roofing of any kind could be obtained. Such timber as was forthcoming was handed over to the field ambulances to make the best use of it they could, but the lack of skilled labour proved another example of the misfortune of having no engineer unit of our own. Fortunately our field ambulances had some handy men among them and with the assistance of a serjeant of the 2nd South Midland, who was a builder by trade, they managed to erect some serviceable shelter huts, roofed with Service blankets and with sides partly of timber and partly of blankets, but open at the front to the south-west. Under great pressure a certain number of bell tents were gleaned from other divisions.

Fortunately these preparations were finished before the storm came and it was possible to find cover and dry clothing and medical comforts for every one of the fifteen hundred patients who were admitted. The blanket roofs kept the wet and wind out wonderfully well and the crowding helped to supply the necessary warmth in the absence of artificial heat.

At one time our then remaining field ambulances, nominally equipped for one hundred and fifty, had over eight hundred patients.

The condition of those who were not maimed by trench feet or crippled by rheumatism rapidly improved, but the storm and its results had shaken us badly and the fear of another spell of bad weather hung over us like a

nightmare. Luckily during the next three weeks the weather was beautifully mild and bright.

The Scottish Horse Field Ambulances had proved themselves exceedingly skilful at improvisation. One of their officers, Captain Wade, afterwards Consulting Surgeon to the Egyptian Expeditionary Force in Palestine, built a first-rate operating hut entirely out of empty cartridge boxes which he found on the beach. This unit possessed a motor operating van which had been presented to them before they left Scotland and which they had managed to keep with them after they had been compelled to shed every other particle of transport. When it was landed it was the only motor vehicle at Suvla. With considerable difficulty it was run round from Suvla to C Beach and ranged up alongside the ammunition-box hut to which it formed an annexe where instruments could be stored, dressings sterilized and electricity manufactured to light the operating hut.

To the Scottish Horse Field Ambulance, thus equipped, were sent all the more serious surgical cases of the Division, and many a man owed his life to the skilled surgical attention he received there.

On October 13 we received a visit from Sir Victor Horsley, who came round as Consulting Surgeon to inspect the surgical arrangements made for the Force.[1] One afternoon he gave us a lecture on "The Immediate Treatment of Head Injuries." Next day I took him round our trenches. He was an untiring walker and an inveterate sightseer; he had three and a half miles to walk from Corps Headquarters, where he was staying, to Lala Baba, and the same back after we had walked steadily all over our area for three and a half hours, so that he must have done seventeen miles, before he got back to his quarters, and the weather was very hot.

An amusing episode had occurred in connexion with Sir Victor Horsley a few months earlier in Cairo. He was then attached to No. 21 General Hospital at Alexandria and had come up to Cairo to see an old friend and pupil, an Australian officer who was seriously ill in the Heliopolis Hospital, suffering from meningitis. He had seen the patient overnight and was going down next morning to see him again before he returned to Alexandria. Everyone knows that Horsley's views on the use of alcohol were uncompromising. While we were breakfasting together at the Continental Hotel a waiter came in and told him he was wanted on the telephone. He came back a minute or two later with a very long face.

"What do you think they want?" he said. "They want me to take two bottles of champagne from the hotel for the patient at Heliopolis. What am I to do?"

I could only suggest that there was no alternative. So he took them. I did not give him away, nor did I take the opportunity of getting a snapshot of him leaving the hotel with the bottles.

[1] The photographs on pp. 404, 407, 409, 410, vol. lxvi and on p. 63, vol. lxvii were taken by Sir Victor Horsley on the occasion of this visit and are reproduced by kind permission of Lady Horsley.

Chapter IX.—The Evacuation.

The question of the evacuation of the Gallipoli Peninsula was raised by the Government at home early in October 1915.

On the 11th a wire was sent out to Sir Ian Hamilton, asking him for an estimate of the losses which would occur in an evacuation of the Peninsula. His reply stated that he considered such a step was unthinkable, owing to the terribly high casualties it would involve. Shortly after, Sir Ian was recalled to England and Sir Charles Munro was sent out to report on the situation generally, and particularly as to whether the Peninsula should be evacuated, or another attempt made to carry it.

Sir Charles arrived at Imbros and took over the command of the Mediterranean Expeditionary Force on October 29, 1915.

After investigation he wired to the Secretary of State for War that in his opinion the evacuation of the Peninsula should be taken in hand.

Lord Kitchener, on receipt of this opinion, decided to make a personal visit to the Peninsula. Very quietly and secretly he made a careful inspection of the whole line. His conclusion coincided with that of Sir Charles Munro, but for some reason nothing was done immediately. It was not until the end of November that directions to prepare a scheme of evacuation were given to General Sir W. Birdwood, then in command of the Dardanelles Army (for Sir Charles Munro's command included Salonica also).

The actual orders to carry out the evacuation of Suvla and Anzac arrived from home on December 9.

The plan devised by Sir William Birdwood for the evacuation is well known. It was a masterly conception and contrary to all precedents of war. It involved a gigantic bluff of the Turks, who were to be kept in ignorance of our intentions until we were gone. As the whole of our position was in full view of the Turks they could observe every movement made in daylight, all embarkation therefore would have to take place at night. The shipping and boats available were only enough to embark a small proportion of the Force on any one night. It was necessary, therefore, to thin the troops down gradually, spending a whole week over the operation, and at the same time, by careful distribution and employment of the remainder to make it appear to the eye of the enemy that no reduction of numbers had taken place. This applied equally to guns and transport if they were also to be embarked.

We had a few advantages. Our position was a very narrow one, and as a complete line of trenches extended from sea to sea it was almost impossible for the Turks to have any spies in the area occupied by us. Also we had such absolute command of the sea that no Turkish vessel of any sort except an occasional submarine at the entrance to the Straits of the Dardanelles ever showed itself on the coast during our occupation. The distance the troops had to move down to the point of embarkation

nowhere exceeded three miles. The plans for the withdrawal were worked out to the minutest detail by the Army and Divisional Staffs.

The deception to be practised by the medical units was an important one. As has already been described, the casualty clearing stations and all the field ambulances on the right of the Suvla position were concentrated on the beach to the south of Nebruniessi Point. They made a line of tents and huts nearly a mile in length on the sea margin and consisted of eight units in all, each of which had been flying a Red Cross flag for many weeks.

Our own four field ambulances were there, the three field ambulances of the 53rd Division and No. 24 Casualty Clearing Station.

Field Ambulance Camp, "C" Beach.

The 53rd Division with its field ambulances left more than a week before the end. One of our field ambulances had gone before this with the two brigades of Yeomanry, and another, the 2nd South Midland, left on December 12. Each field ambulance left its camp standing and its flag flying as if it were still there. The two remaining field ambulances had to spread themselves over the whole line of camps, and by lighting fires in the various kitchens, and putting lights in the tents at night made it appear that that they were all still occupied.

The final evacuation took place on the night of December 19. As time drew on the tension became greater and greater. Three weeks had elapsed since the great storm, and by all previous records another was due. With anything like a strong wind from the west or south, embarkation was impossible, and should a storm come on during the evacuation period, after the numbers had become seriously depleted, the position would be most grave. However, the fates were kind and the weather remained perfect until the evacuation was completed.

In our divisional scheme, which was published on December 16, though much preparatory work had been done before that date, the Division, the strength of which, on December 12, had been 3,125, was to be reduced by dispatch of details before the penultimate night, December 18, to just over 2,000.

On the night of the 18th, the South Western Brigade (from the reserve trenches) and further details from the rest of the Division were to leave, reducing the total strength to 500 men in each brigade in the trenches—the Scottish Horse and the Highland—and to 135 in the rest of the Division, including the Royal Engineers, Headquarters Staff and Bearer Sub-Division.

It was more convenient for the 4th Gurkhas, Anzac Force, who held the extreme left of their line, to evacuate by our route; 400 of them, therefore, embarked with the remnant of our Division.

On the last day, December 19, the troops were to leave the trenches after dark in three parties: the first, consisting of half their number, just after dusk at 5.45 p.m.; the second, comprising two-thirds of the remainder, at 10 p.m., and the rearguard, sixty men of each brigade, at 1.30 a.m. on the 20th.

Every man had to carry his arms and all that was left of his kit. The heavier baggage had been sent away before, but the machine guns had to be carried by hand the whole two and a half miles.

An elaborate system of trip mines had been prepared in front of our first line trenches and also across the open parts of the plain between our trenches and the embarkation points. Almost at the last moment it was decided not to charge those behind our trenches, lest they should be set off by stragglers inadvertently leaving the regular tracks.

A great deal of ingenuity had been exercised in devising automatic rifles to go off at intervals during the night in the trenches after the troops had left, by means of burning candles, falling sand, etc.

The medical arrangements for evacuation were most carefully worked out. Every hospital unit was kept completely cleared of patients for some days before the end.

It was arranged that if casualties occurred during the withdrawal they were to be taken to the Casualty Clearing Stations, and if these could not be cleared by the Navy before the Turks came down, detachments were to be left behind at the last moment to take charge of the patients who fell into the hands of the Turks.

A small detachment of each of the two remaining field ambulances was posted about half way up the roads down which the parties came and was to withdraw with the rearguard and embark with them. A dressing station was to be formed if necessary near the embarkation point.

The one point in our Divisional scheme which was left open was the embarkation point itself. If the weather remained fine it was to be on the beach to the south of Nebruniessi Point, between the Point and the

casualty clearing station. If the sea was rough, it was to be at the pier to the north of the Point, which was more or less sheltered from the south and south-west, otherwise this pier was reserved for the embarkation of our next neighbours on the left, the 13th Division.

As it turned out, the first alternative was adopted for the sea was perfectly calm.

The last day was one of great anxiety for the remnant that was left. To our eyes the whole area looked so bare and deserted that it seemed impossible that it did not appear so to the enemy also. The weather looked threatening in the morning, but cleared up later in the day. During the morning the Turks shelled our embarkation place and the roads approaching it as if they were registering on them and they actually dropped a shell on the pier which the 13th Division were going to use. Fortunately it dropped between two supports and the damage was quickly repaired. As dusk approached the excitement became intense. There was nothing to do but to wait as patiently as we could. Our reduced staff, without servants except one cook, sat out the evening in our old quarters on Lala Baba, trying to pretend we were calm and unmoved. The silence outside was unbroken. No shot audible to us was fired all the evening. It was not the custom of the Turks to fire with artillery after dark and they did not break their rule on this occasion. A little after ten the telephone from the Brigade Headquarters announced the second party had left the trenches. This was the signal for our own departure.

Every officer carrying his own kit, or all that was left of it, we sauntered slowly down to the beach for all the world as if we were off for a holiday. The night was perfect, the moon nearly full and the air was soft and mild. A slight haze covered the sea so that the ships could come quite close in without risk of being observed. On the beach we found the first party already well on the way with embarkation. We waited quietly on the shore until the second party had arrived, about 11.30 p.m., and then got on board ourselves. The last party arrived about 3 a.m., and then up anchor and away we went. The casualty clearing station party had no patients to deal with and were taken off in a naval boat. Just as we were leaving, fire was put to the large hollow stacks of supplies near our embarkation point and as we left the flames mounted to the sky as a farewell bonfire. No apparent notice was taken of it by the Turks while we were there.

The feelings that filled us as we left the shore are more easily imagined than described. After one of devout thankfulness for our almost miraculous escape, came the feeling of astonishment at the extraordinary failure of observation on the part of the Turks, then the relief, after four weary months, of being out of reach of the everlasting bombardment from which no spot in the area occupied by us was completely safe, and lastly the feeling of joy in the comforts of the ship to those of us who had never set foot off the Peninsula since we landed.

There were unkind people at Home who suggested that the Turks had

been paid to let us go, or at any rate had let us go voluntarily. There were no grounds for this statement. A letter from a German artillery officer serving with the Turks, published in the Press some time afterwards, showed what an absolute surprise it was to them all on the morning of the 20th to find that we had gone. He described how he had looked down on our position from the hills behind Anafarta the evening before, while planning some new gun positions. To his eyes everything in our lines appeared as usual and it was with the utmost astonishment that he learned next morning that his plans of the previous evening were no longer required as the English had gone.

The evacuation of Anzac had been carried out simultaneously with that of Suvla and with equal success. The force at Cape Helles remained for another three weeks and then got away with little more difficulty than we had had.

Our immediate destination was the Island of Imbros, fifteen miles away, on which General Headquarters had been stationed for so long. It was daylight when we reached there, and we were welcomed by those who had come over before us.

After two days' rest at Imbros, which gave us little time to explore our new quarters, the Division embarked for Mudros and without landing there we changed ship and went straight to Egypt. Christmas Day was spent at sea, and Alexandria reached on December 27 without any adventure.

Thus ended, as far as we were concerned, one of the most interesting expeditions ever undertaken by British Arms. It was a failure, a complete failure in its main object, but the event and the successful operation of withdrawal entirely wiped out any feeling of despondency that we had at the unsatisfactory result. The *morale* of the men who remained to the last was quite unshaken. Their health had greatly improved during the last weeks and never for one moment had they lost their sense of fighting superiority over the enemy who, though too much for us in the defence when backed by superiority in numbers and position, never gave us a moment's real anxiety in the attack.

(*To be continued.*)

Current Literature.

STROMQUIST. **Malaria Control in the Tennessee Valley.** *Civil Engineering*. December, 1935, Vol. v, No. 12.

The Tennessee Valley Scheme is an effort on the part of the Federal Government of the United States to provide cheap electric power in the South-Eastern States. The right of the Central Government to engage in

such activities has recently been the subject of an important action before the Supreme Court of the United States, and, apparently because the scheme under consideration also deals with flood control and navigation on the Tennessee River and its tributaries, the Court has decided that the project falls within the constitutional powers of the Federal authorities.

The scheme involves the construction of four artificial lakes, one of which, the Wilson Reservoir, has already been completed. When the dams of the others are finished an additional shore line of approximately 2,300 miles will have been created in an area which already suffers from endemic malaria.

In the design and construction of the dams and reservoirs the engineers have paid close attention to the factors necessary for the control of mosquito development along this huge stretch of potential breeding area. It is pointed out that the main essential is the proper preparation of the basins involving clearing to provide a clean shore line and a clear water surface, together with efficient drainage of all areas liable to retain water when the water level in the reservoirs falls.

The general idea is that water levels in the reservoirs will be at a maximum during the winter and spring, and will be lowered at the beginning of the mosquito breeding season. These seasonal changes in water levels are intended to inhibit the growth of vegetation while the bulk of the floating débris will be left stranded as the water recedes.

Provision is also being made for periodic lowering of the water levels at intervals of seven to ten days during the breeding season, a procedure which will tend to reduce the growth of aquatic vegetation and at the same time will cause anopheline larvæ either to be stranded or swept into the open water where they will be more liable to the attacks of their natural enemies the presence of which is being ensured by stocking the reservoirs with top feeding minnows.

The use of oil and paris green and the methods of application likely to be most efficient are also discussed while charts showing the effects of these measures on the Wilson Reservoir and during the construction of the Norris dam are included.

From the observations already made it is concluded that there is irrefutable evidence of the value of fluctuation of water levels in the control of mosquito breeding in impounded waters, and that with satisfactory design and construction the control can be maintained without seriously interfering with power production.

This paper is an excellent description of modern engineering methods as applied to the construction of such artificial reservoirs in malarious areas and emphasizes the value of close co-operation between the engineer and the malariologist, a co-operation which in the case of the Tennessee Valley project seems to be of the happiest nature.

GILL, C. A. **Some Points in the Epidemiology of Malaria Arising out of the Study of the Malaria Epidemic in Ceylon in 1934-35.** *Trans. Roy. Soc. Trop. Med. and Hyg.* Feb., 1936, V. 29, No. 5.

In the introduction to this paper, Colonel Gill emphasizes the powerlessness of modern medicine to prevent the outbreak of malaria epidemics or to check their course, and further states that, as regards Ceylon, it was not possible to suggest any practicable scheme for controlling malaria in an area embracing almost three-quarters of the island.

For these reasons he considers that it is imperatively necessary to fill some of the gaps in our knowledge of the endemiology and epidemiology of the disease, and a study of the Ceylon epidemic may help.

The author then summarizes previous work on the epidemiology of malaria, quoting Christophers as stating that "the exact mechanism of epidemic causation is still unknown, but the epidemic condition appears to be due to an excessive seasonal increase of the parasite rate, fluctuations in which occur even in healthy years." He also quotes his own work on the effects of humidity and temperature on the insect carrier and on the parasite in the mosquito and his suggestion that the sudden rise of atmospheric humidity might possibly exercise a direct effect on the parasite in the human body.

Passing on to consider conditions in Ceylon, he points out that temperature and humidity are always favourable for the development of malaria. The drought in the summer of 1934 caused a marked drop in the relative humidity in the central districts. A remarkable feature of the climate of the island is that in the south-west corner or Wet Zone rainfall is due to both the south-west and north-east monsoons and appreciable falls are registered in every month of the year, the annual fall varying from 70 to 200 inches. In the Dry Zone there is an annual fall of from 25 to 50 inches during the north-east monsoon, and from May to October no rainfalls in this area.

In the south-west corner the health of the population is good and the spleen-rate is 0 to 5, but a broad belt at the northern limit of the Wet Zone shows a spleen-rate of 20 to 40, and this rate increases to the north and east of the island.

The epidemic began in November, 1934, and continued till March, 1935. A graphic representation of its intensity shows the focal character previously described by Christophers as occurring in epidemics in the Punjab.

The epidemic centre occurred in three adjoining districts with epidemic figures of 7 to 12 and shaded off in all directions, the area affected coinciding roughly with the districts in which the spleen-rate is normally moderate.

The onset of the epidemic was heralded by a slight increase of hospital attendances late in September and early in October with a sudden sharp rise in the north of the area in the last week of October.

The epidemic history of the island shows a five-year periodicity in the appearance of epidemics of malaria and 1934 was a year in which an epidemic was to be expected. Both summer and winter show seasonal increases of the disease in the Wet Zone, but in the Dry Zone the seasonal outbreaks are in the winter only.

Examination of data extending over a period of thirty-four years shows that a deficiency of rainfall during July, August, and September, has been favourable to the occurrence of a winter epidemic in the Wet Zone, while excessive winter rainfall leads to winter epidemics in the Dry Zone. The drought preceding the present epidemic lasted from July to September and the outbreak is described as a Wet Zone epidemic.

A. culicifacies is the carrier species of importance to the island, but is regarded as an inhabitant of the Dry Zone, although it is usually abundant in the Wet Zone during years of drought. In November, 1934, it was unusually prevalent in the catchments of the rivers draining to the west coast, in the south-west quarter of the island and in December this species showed a carrier rate of 12·9 per cent.

The benign tertian parasite played a predominant part in the early stages of the epidemic but gave place to the malignant tertian parasite towards its close.

In studying the epidemic curve attention was mainly confined to the town of Kurunegala with a population of 10,500 and here it was found that the normal attendances at the Civil Hospital were doubled on October 29, 1934. A similar rapid rise was shown by the attendances at other hospitals and dispensaries in the epidemic area.

The morbidity curve shows a primary wave presenting four peaks at intervals of approximately one month, the first occurring in the week ending November 10 and the fourth in the week ending February 2. A second wave begins in the middle of April. Curves showing similar features have been obtained in epidemics in India.

The mortality curve shows a small rise in the third week of the epidemic, and then rises slowly till the seventh week, when a sharp rise occurs mainly due to increased mortality in the 0 to 10 age-group. The complete curve shows three peaks of mortality at intervals of about four weeks.

In explanation of the facts noted, it is stated that the long lag of six weeks between the first sharp rise of morbidity and the first increase of mortality appears to imply that no new infections occurred among children in the early stages of the epidemic, and additional evidence is brought forward in support of this conclusion.

Furthermore, to permit of the simultaneous onset at the end of October of a large number of cases of malaria scattered over a wide area, if the current beliefs in the mode of origin of malaria epidemics are correct, implies the assumption that a large number of anophelines had become infected from such human carriers as existed during a period when the public health was good; that these infected mosquitoes had dispersed and in due

course had infected a large number of persons, *excluding children*, who then commenced to fall ill simultaneously. The author considers that such a sequence of events is improbable and holds that the sickness during the first month of the epidemic was due to an "epidemic of relapses," the second and subsequent peaks in the primary wave of morbidity being due to fresh infections.

The second wave in April also affected the whole epidemic area, the morbidity increasing as abruptly as it did at the onset of the primary wave. It occurred contemporaneously with an increase in the infection rate of *A. culicifacies*, and was followed by a wave of increased mortality. It is also regarded as having been initiated by a wave of relapses.

A study of the epidemic curve points to the conclusion that two factors are concerned in the production of the epidemic wave. The first of these is concerned with the precipitation of an epidemic of relapses, and has nothing to do with the *immediate* presence of anopheline carriers. The second factor is concerned with a quantitative relationship between the number of anopheline carriers and the number of non-immunes in the population concerned; while the magnitude of an epidemic depends on the conjunction of both factors under favourable conditions.

It is conceivable that the sharp rise of atmospheric humidity which occurred three weeks before the onset of the epidemic exercised an influence on the human carriers and caused relapses.

As the method of measuring the intensity of a malaria epidemic is by the rise in mortality especially among children (non-immunes) it follows that an epidemic of high intensity can only occur when the proportion of children is high. It likewise follows that there must be an adequate reservoir of infection, an abundance of insect carriers and suitable environmental conditions.

The hypothesis put forward postulates that given these conditions the distribution and focal character of an epidemic will be determined by the magnitude of the "epidemic potential" and it is significant that the focal distribution of the Ceylon epidemic corresponded closely with the excess over normal of the rise in the relative humidity.

By postulating that a rise in atmospheric humidity is an essential precursor of a malaria epidemic it is possible to explain why in north India excessive rainfall is an essential determining cause while in Ceylon epidemics are invariably associated with drought. The significant factor is not the percentage of relative humidity but the rise which it undergoes in the pre-epidemic period, a rise which is common to both cases.

In view of the part played by floods and droughts in determining epidemics of malaria it follows that meteorological cycles associated with the periodic occurrence of floods and droughts may occasion the periodicity of malaria epidemics, a periodicity which usually shows a ten-year interval, and it has been suggested that there may be some relation to the sun spot cycle which takes from ten to twelve years from minimum to minimum.

A graph shows a remarkable association of great malaria epidemics with epochs of minimum and maximum sun-spot numbers.

The Ceylon epidemic occurred in association with a new sun-spot cycle which began in 1934.

Reviews.

AN INDEX OF TREATMENT. Edited by Robert Hutchison, M.D., LL.D., F.R.C.P. Bristol: John Wright and Sons, Ltd. 1936. Pp. xv + 1020. Price 42s. net.

The eleventh edition of this well-known treatise is in similar form to former volumes. It has been revised throughout and several new chapters appear for the first time. This truly remarkable work is already familiar to all practising medical men in both this and many other countries. A volume which covers not only the actual treatment of almost every complaint in Medicine, Surgery and Tropical Disease, but also includes well-expressed and carefully written articles on symptomatology and ætiology, must of necessity be a big one. The editors have solved the problem of keeping the work within one volume exceedingly well, to the great advantage of a work of this kind. The new chapters bring this book up to date upon such diseases as agranulocytosis, cœliac disease, and other conditions, the subjects of recent research. We are glad to see retained the numerous useful formulæ. The list of contributors includes the majority of well-known teachers of medicine and surgery of the present day and for this reason the treatise is an exceedingly useful work within a compass of practical dimensions. It should be available for reference in all medical libraries, as well as consulting rooms. J. H.-S.

FOUNDATIONS OF SOLDIERING: A NEW STUDY OF REGIMENTAL SOLDIERING IN THE BRITISH ARMY. By Major M. K. Wardle, D.S.O., M.C. Aldershot: Gale and Polden, Ltd. 1936. Pp. viii + 159. Price 3s. 6d.

This book deals with the training from the platoon to "higher training" of the regimental officer.

The author "seeks to exalt the platoon and its commander into their true position of paramount importance in our Army." This is the unit on which, rightly, the author chiefly bases his foundations.

Although the work is intended primarily for the guidance of infantry officers, the writer considers that it may be applied, with suitable emendations, to other arms of the Service. With this we agree, as there is much in this brightly written book that can be read with profit by officers and N.C.O.s of the Corps.

We particularly liked the examples of "wrong way" and "better way" demonstrations of small routine duties, with the aim of bringing leadership to the smaller tasks in Army life. By the manner in which these small tasks are performed is reflected the cheerfulness and smartness of his men. "Sloppiness" is certainly the author's bugbear.

One word of dissent: We do not altogether agree with the statement on page 129 ("Lecture No. 5: Venereal Disease") that the men "think it is the M.O.'s job to frighten them," although possibly in the past some medical officers could be blamed for being over zealous. It is for other reasons that we agree that these lectures should be given by the Platoon Officer, as he is in closer touch with his men.

THE TREATMENT OF VENEREAL DISEASE IN GENERAL PRACTICE. By Thomas Anwyl-Davies, M.D., B.S.Lond., M.R.C.P.Lond. London: John Bale, Sons and Danielsson, Ltd. Pp. vi + 202. Price 7s. 6d.

The author in his preface states that his aim is to include in a small space all the essentials of treatment of venereal disease to guide practitioners in the management of their cases, to help medical officers resident abroad to utilize their limited resources to the best advantage, and to provide sufficient data for senior students for examination purposes. A surprising amount of useful information has been crammed into a small space.

With so large a subject it is admittedly difficult to know what to include and what to omit, but it would appear that too much space has been taken up by the description of the detailed chemical composition of organic arsenical preparations and theories as to their mode of action; such information is of less value to the busy practitioner than would be, for instance, more detailed instructions as to the treatment of chancroid, which is dismissed in under a page and a half.

Tests of cure for gonorrhœa such as those advocated are ideal and could be carried out in a venereal clinic, but would be difficult or even impossible in the average general practice.

On the whole this monograph appears to be rather a description of methods adopted at the Whitechapel clinic than a textbook of treatment in general practice.

H. G. W.

ILLUSTRATIONS OF REGIONAL ANATOMY. By E. B. Jamieson, M.D., Senior Demonstrator and Lecturer, Anatomy Department, University, Edinburgh. Edinburgh: E. and S. Livingstone. 1934. 30s. net.

There are five sections (Central Nervous System, Head and Neck, Abdomen, Pelvis, and Thorax) in separate volumes. Each volume consists of loose-leaf plates, the majority in colours.

The illustrations are on one side of the page only, so that any page can be detached for pasting into a notebook.

Some of the diagrams, as the author states, are schematic representations from specimens prepared by himself, whilst in others the artist has provided the foundation and the author has drafted in details.

Both author and artist are to be very highly complimented on the result.

The illustrations are clear, accurate and excellent in every way; they should be extremely helpful in the study of anatomy. The price is very reasonable at 30s. the set.

J. M. W.

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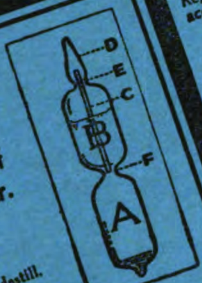

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The above is an extract from an interesting pamphlet we have just issued concerning Cystopurin. A copy of this, with clinical samples of Cystopurin, will gladly be forwarded on request to

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CYSTOPURIN

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We regret to announce that

Lieutenant-General SIR ALFRED KEOGH,

G.C.B., G.C V.O., C.H.,

died in London on July 30. *A memoir and appreciation will be published in the September number of the Journal.*

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Journal

of the

Royal Army Medical Corps.

Original Communications.

THE AMMONIA-CHLORINE TREATMENT OF WATER.

EXPERIMENTS WITH WATERS OF DIFFERENT DEGREES OF ACIDITY AND ALKALINITY AND VARYING AMOUNTS OF POLLUTION.

BY MAJOR S. ELLIOTT, O.B.E., T.D., B.SC., F.I.C.,
Analyst, Royal Army Medical College.

INTRODUCTION.

THE fact that the sterilizing action of ammonia-chlorine is delayed in highly alkaline waters was first brought to our notice in 1934 by Major E. F. W. Mackenzie, O.B.E., M.C., who was then Director of the Food Laboratory at Kasauli. Since then his results have been published in this Journal, vol. lxvi, pages 217 and 289.

The following investigations were carried out at the Royal Army Medical College in consequence of the above communication, and it will be seen that the results are in close agreement with Mackenzie's findings.

THE PROBLEMS TO BE INVESTIGATED.

(1) What is the highest degree of alkalinity likely to be met with in a natural water?

(2) Do any of the usual purification treatments cause an alteration in the reaction of the water?

(3) Do highly alkaline waters delay the action of chlorine and ammonia-chlorine on organisms in water?

(4) To what extent can waters with different reactions be polluted before ammonia-chlorine (Harold-McKibbin process) fails to cause the death of *B. coli* in fifty millilitres of the water?

(5) What is the effect of increasing the dose of ammonia-chlorine in heavily polluted water?

(6) Does the Harold-McKibbin process kill cholera organisms in one hour in the most alkaline waters, disregarding medicinal waters, likely to be met with in Nature?

(7) How does chlorine compare with ammonia-chlorine in killing cholera organisms in polluted alkaline water?

(8) Is ammonia-chlorine as effective after standing twenty-four hours as it is when freshly made?

Results of Experimental Work.

(1) *What is the highest degree of alkalinity likely to be met with in a natural water?*

(*a*) Britton, in "Hydrogen Ions," second edition, page 514, states that water in the alkaline soil of the Sudan has a pH value of 10·0 due to the presence of sodium carbonate.

(*b*) A saturated solution of magnesium carbonate in distilled water has a pH value of 10·7 as determined with a glass electrode. Carbonation of this water with carbon dioxide gas rendered it less alkaline, and its pH value was then found to be 7·0 (neutral). Addition of urine in the proportion of 1 part in 5,000 reduced the alkalinity to a pH value of 10·0, presumably due to the action of the phosphates in the urine acting as a buffer.

(*c*) Dr. Suckling, who has had a very wide experience of the waters in the Thames estuary and in Essex, has informed me that the alkalinity of these waters seldom exceeds a pH value of 8·0, and never more than 8·5. These waters contain sodium bicarbonate derived from the original chalk in them by the action of naturally occurring zeolite minerals.

The pH value of a saturated solution of sodium bicarbonate determined with a glass electrode is about 8·4.

(*d*) The hard alkaline waters in the Punjab in India are said to have a pH value of 8·1.

(*e*) The hard chalk waters of Salisbury Plain have a pH value varying from 7·5 to 8·0, but they are never more alkaline than a pH value of 8·0.

It must therefore be concluded that so far as is at present known, the most alkaline water likely to be found in Nature other than medicinal waters has not an alkalinity greater than a pH value of 9·0.

(2) *Do any of the usual purification treatments cause an alteration in the reaction of the water?*

(*a*) Clarification by sedimentation with alum compounds requires a pH value of between 6·5 and 7·0 for efficient working. Hence this treatment may alter the reaction to neutral, but it does not create excessive alkalinity.

(*b*) Clarification by filtration does not alter the reaction unless "filter aids" are used. These are usually composed of alum and soda, and experiments with the Army water cart using Service water clarifying powder showed that waters with pH values varying from 4·1 to 8·8 were made

slightly more alkaline to the extent of a pH value of 0·1 to 0·2 only. With the new Service water clarifying powder, which consists of fifty parts of the old powder and fifty parts of kieselguhr, the change in reaction is even less marked.

(*c*) Sterilization of water by the Harold-McKibbin method altered the pH value 0·25 to 0·30, making the water slightly more alkaline owing to free lime in the water sterilizing powder. Ordinary sterilization by water sterilizing powder, without the use of ammonia, causes the same increase in alkalinity.

(*d*) Sterilization by means of electrolytic chlorine as carried out in the Elliott mobile water purifier was found to cause no change.

It must, therefore, be concluded that purification treatment of water as carried out in the Army does not materially alter the reaction of a water.

(3) *Do highly alkaline waters delay the action of chlorine and ammonia-chlorine on the organisms in water?*

(*a*) Water used: London tap-water with a pH value of 7·5 and the reaction adjusted to the required value by the addition of either lactic acid or sodium carbonate.

(*b*) Test organism: A twenty-four-hour culture of *B. coli* on an agar slope emulsified in 10 millilitres of "normal" saline. One millilitre was used for each litre of water. MacConkey's medium with Andrade's indicator was used to test whether the organisms were killed or not; 50 millilitres of water and two days' incubation were employed. The production of acid and gas was considered positive.

(*c*) Concentrations of ammonia-chlorine and of chlorine were determined by titrating 355 millilitres of the water to which potassium iodide and starch had been added with N/100 sodium thiosulphate solution. Each millilitre required to discharge the blue colour represented one part per million of free chlorine as chlorine or ammonia-chlorine.

(*d*) Method: Specimens of the waters of various reactions at about 60° F. were placed in glass jars in a north window, and one millilitre of the saline suspension was added to each. At zero time the ammonia-chlorine was added in the correct proportions according to the Harold-McKibbin method; or, alternatively, water sterilizing powder alone was added in the correct proportion according to the Horrocks test.

Immediately afterwards, fifty millilitres were inoculated into double strength MacConkey tubes, which, for this "zero time" test, contained traces of potassium iodide and starch. As no blue colour was produced, it was concluded that the sterilizing agent was immediately destroyed by the broth; hence no sterilizing action could vitiate the results. At the same time, the concentration of chlorine was determined.

Every six minutes after zero time fifty millilitre samples were inoculated into the broth as before, and the concentration of chlorine was again determined at the end of the test.

(*e*) The results were as follows :—

TABLE I.

Effect of the reaction of water on the rate of sterilization by the Harold-McKibbin method.

pH value	Initial chlorine	Residual chlorine	Time of contact in minutes										
			0	6	12	18	24	30	36	42	48	54	60
3·2	1·7	1·4	±	–	–	–	–	–	–	–	–	–	–
6·8	1·7	1·7	±	±	±	±	–	–	–	–	–	–	–
7·7	1·7	1·7	±	±	±	±	±	±	–	–	–	–	–
8·5	1·9	1·7	±	±	±	±	±	±	±	±	–	–	–
9·0	1·8	1·7	±	±	±	±	±	±	±	±	±	±	±

TABLE II.

Effect of the reaction of water on the rate of sterilization by water sterilizing powder alone, the Horrocks test showing that one part per million was required.

pH value	Initial chlorine	Residual chlorine	Time of contact in minutes										
			0	6	12	18	24	30	36	42	48	54	60
3·75	1·0	0·7	±	–	–	–	–	–	–	–	–	–	–
4·8	1·0	0·7	±	±	–	–	–	–	–	–	–	–	–
6·7	0·9	0·7	±	±	±	–	–	–	–	–	–	–	–
8·0	0·9	0·7	±	±	±	±	–	–	–	–	–	–	–
9·0	0·7	0·7	±	±	±	±	±	±	–	–	–	–	–

A ± sign indicates non-sterility, while a minus sign indicates that the medium was sterile.

Therefore, the more alkaline the water the slower is the rate of sterilization in the case of both chlorine by itself and ammonia-chlorine (Harold-McKibbin method).

(4) *To what extent can waters with different reactions be polluted before ammonia-chlorine (Harold-McKibbin method) fails to cause the death of* B. coli *in fifty millilitres of the water?*

(*a*) Water used : London tap water brought to the required reaction with either hydrochloric acid or sodium carbonate. Units of fifty gallons each in fifty gallon new tanks of galvanized iron were used.

(*b*) Test organism : *B. coli,* twenty-four hour agar slope cultures suspended in 10 millilitres of "normal" saline and 2·5 millilitres were used for each tank.

(*c*) Polluting agent : Fresh or stale urine, twenty-four hours old collected from a number of persons in order to avoid abnormalities in the urine, was considered better than fæces as it is free from particulate matter. If water contains particulate matter it is potentially dangerous to drink on account of the probable presence of mica, the ova of worms, or the cysts of *Entamœba histolytica* which are not killed by the ordinary dose of chlorine given to water. Moreover, urine contains ammonia which retards the rate of sterilization of water by chlorine or ammonia-chlorine.

(*d*) Dose of sterilizing agent : One 5-grain tablet of ammonium chloride and one 30-grain scoop of water sterilizing powder suspended in water were added to each 50-gallon tank.

(*e*) Method : To the water in each tank was added the requisite amount of urine and the organisms ; the pH value was then adjusted to the required

degree by the addition of acid or alkali. The ammonium chloride and the water sterilizing powder were added at zero time and samples taken for the determination of the chlorine, the pH value, and for inoculation of the fifty millilitre MacConkey tubes. The chlorine content of the waters at the commencement averaged 1·5 parts per million.

The tanks were covered for one hour and at the end of that time further samples were taken for the determination of the chlorine, the pH value, and for inoculation into MacConkey tubes. The chlorine content at the end of the hour varied directly as the proportion of urine, being 0·4 part per million in the most heavily polluted water. The pH value did not change.

The MacConkey tubes were incubated for two days at 37° C.

The results of treating water containing both fresh and stale urine are given in the following tables:—

TABLE III.

Results of treating waters of various reactions containing different proportions of *fresh urine* by the Harold-McKibbin method.

pH value	Proportion of fresh urine to water. One part in—											
	300	500	700	900	1,000	3,000	4,000	5,000	7,000	9,000	11,000	13,000
4·5	–	–	–	–	–	–	–	–	–	–	–	–
5·5	±	–	–	–	–	–	–	–	–	–	–	–
6 5	±	±	–	–	–	–	–	–	–	–	–	–
7·5	±	±	–	–	±	–	–	–	–	–	–	–
8·5	±	±	±	±	±	±	±	–	–	–	–	–
9·0	±	±	±	±	±	±	±	±	±	±	–	–

TABLE IV.

Results of treating waters of various reactions containing different proportions of *stale urine* by the Harold-McKibbin method.

pH value	Proportion of stale urine to water. One part in—										
	300	500	700	900	1,000	2,000	3,000	4,000	5,000	6,000	9,000
5·5	–	–	–	–	–	–	–	–	–	–	–
6·5	±	–	–	–	–	–	–	–	–	–	–
7·5	±	–	–	–	–	–	–	–	–	–	–
8·5	±	±	±	±	±	±	±	–	–	–	–
9·0	±	±	±	±	±	±	±	±	±	±	–

A ± sign indicates non-sterility, while a minus sign indicates sterility.

Conclusion :—The Harold-McKibbin method is capable of sterilizing a water with a pH value as high as 8·5 containing a pollution of one part of either fresh or stale urine in 5,000.

(5) *What is the effect of increasing the dose of ammonia-chlorine in heavily polluted alkaline waters?*

The experimental details of these tests were similar to those in the preceding section (4), but one and a half times the quantities of ammonium chloride and water sterilizing powder were used. The initial proportion of chlorine amounted to between 2·6 and 2·7 parts per million, the final proportion at the end of one hour with a dilution of 1 part of urine in

5,000 was 2·6 and when the dilution was 1 : 200 the concentration was 1·0 part per million.

The results were as follows :—

TABLE V.

Results of treating waters with various reactions, containing different proportions of fresh urine with an increased dose of ammonia-chlorine.

pH value	Proportion of fresh urine to water. One part in—									
	300	500	700	900	1,000	2,000	3,000	4,000	5,000	6,000
5·5	–	–	–	–	–	–	–	–	–	–
6·5	–	–	–	–	–	–	–	–	–	–
7·5	±	–	–	–	–	–	–	–	–	–
8·5	±	±	±	±	±	–	–	–	–	–
9·0	±	±	±	±	±	±	±	±	±	–

A ± sign indicates non-sterility, a minus sign indicates sterility.

Therefore an increased dose of ammonia-chlorine will sterilize a very heavily polluted water without giving it an objectionable taste, as it requires over 3·0 parts of ammonia-chlorine per million to give any appreciable taste to water even if it contains phenols.

(6) *Does the Harold-McKibbin method kill cholera organisms in one hour in the most alkaline waters, disregarding medicinal waters likely to be met with in Nature?*

(*a*) The water used was distilled water saturated with magnesium carbonate, having a pH value of 10·5. Units of one quart were placed in covered glass jars and no pollution was added.

(*b*) The organism : " Water vibrio No. 811/5 Kasauli " was supplied by the Pathological Department, Royal Army Medical College, and was grown on alkaline agar for twenty-four hours at 37° C. A suspension in ten millilitres of " normal " saline was made and one millilitre added to each quart of alkaline water in the jars.

(*c*) The requisite quantities of solution of ammonium chloride and suspension of water sterilizing powder were added at zero time.

(*d*) Method : Immediately after the addition of the chemicals, samples were taken for the determination of chlorine and for ascertaining whether the organisms were alive. After one hour and again after one and a half hours, the same procedure was carried out, the jars standing in a north window at about 60° F.

The test for the presence of live organisms was carried out as follows : Plugged measuring flasks of 100 millilitre capacity containing 50 millilitres of double strength peptone water with a trace of potassium iodide and starch were inoculated by pouring in the water until the 100 millilitre mark was reached. In no case was any blue colour produced, showing that no ammonia-chlorine was left to carry on a sterilizing action. The flasks were then incubated at 37° C. for two days and the formation of a pellicle on the surface, an obvious growth in the medium, and a cholera red reaction on the addition of sodium nitrite were regarded as positive.

The results were as follows :—

TABLE VI.

Results of the action of the Harold-McKibbin method on water with a pH value of 10·5 containing cholera organisms.

Experiment No.	Initial chlorine	Residual chlorine	Zero time	One hour contact	One and a half hours contact
1	1·7	1·6	Positive	Positive	Negative
2	1·8	1·7	Positive	Positive	Negative

The Harold-McKibbin method does not kill cholera organisms in such a water in one hour, but does so in one hour and a half.

(7) *How does chlorine compare with ammonia-chlorine in killing cholera organisms in polluted alkaline waters?*

(*a*) Water used: Distilled water saturated with magnesium carbonate was polluted with 1 : 5,000 of mixed fresh urine. Units of one quart were placed in covered glass jars.

(*b*) Organisms used: Two strains "Water vibrio No. 811/5 Kasauli" and "Vibrio choleræ Hikojima" were used in the same quantities as in the preceding section (6).

(*c*) The ammonia-chlorine was added as in the preceding section (6), but in the case of the chlorine alone a preliminary Horrocks test was carried out and it indicated that two parts of chlorine per million were required.

(*d*) Method: The method was similar to that carried out in the preceding section (6).

The results were as follows :—

TABLE VII.

Results of the action of the Harold-McKibbin method on water with a pH value of 10·0, containing 1 : 5,000 of fresh urine and also cholera organisms.

Type of organism	Initial chlorine	Residual chlorine	Zero time	One hour contact	One and a half hour contact
Japanese	1·9	1·8	Positive	Positive	Negative
Japanese	1·9	1·7	Positive	Positive	Negative
Kasauli	1·9	1·6	Positive	Positive	Negative
Kasauli	1·9	1·8	Positive	Negative	Negative

TABLE VIII.

Results of the action of chlorine alone in amount as indicated by the Horrocks test on water with a pH value of 10·0 containing 1 : 5,000 of fresh urine and also chlolera organisms.

Type of organism	Initial chlorine	Residual chlorine	Zero time	One hour contact	One and a half hour contact
Japanese	1·9	1·2	Positive	Negative	Negative
Japanese	1·8	1·0	Positive	Negative	Negative
Kasauli	1·9	1·0	Positive	Negative	Negative
Kasauli	1·8	0·8	Positive	Positive	Negative

Therefore under the above conditions, both ammonia-chlorine and chlorine alone take longer to kill cholera organisms than the usually accepted times of one hour and half an hour respectively.

(8) *Is ammonia-chlorine just as effective after standing twenty-four hours as it is when freshly made?*

First Experiment.—(*a*) Water used: London tap water with a pH value of 7·5 in fifty gallon galvanized iron tanks.

(*b*) Test organism: *B. coli* grown for twenty-four hours on an agar slope and a suspension made in 10 millilitres of "normal saline." The whole 10 millilitres was added to the 50 gallons of water.

(*c*) One ammonium chloride tablet (five grains) and a suspension of thirty grains of water sterilizing powder were the sterilizing agents.

(*d*) Test medium: MacConkey's broth in fifty millilitre tubes of double strength were used and the production of acid and gas in two days' incubation at 37° C. was regarded as positive.

(*e*) Method: At zero time the sterilizing chemicals were added, fifty millilitres of the water were pipetted into a tube of MacConkey's broth, and the proportion of chlorine determined. Every fifteen minutes fifty millilitres of the water were pipetted into fresh tubes until ninety minutes had elapsed.

The tanks were left covered for twenty-four hours, when ten millilitres of a fresh saline suspension of *B. coli* were added without any further addition of sterilizing chemicals, and a similar procedure was carried out.

The results were as follows:—

TABLE IX.

Minutes:	0	30	45	60	75	90
Initial chlorine ..	1·75					1·75
MacConkey tubes..	AG	AG	AG	AG	Nil	Nil
Residual chlorine.. (24 hours)	0·65					0·65
MacConkey tubes..	AG	AG	AG	AG	AG	AG

AG represents that the tubes had acid and gas; Nil represents sterility.

Second Experiment.—It was considered unfair to compare the rates of sterilization in waters containing 1·75 and 0·65 parts of chlorine per million, so a further experiment with two tanks, each containing fifty gallons of London tap water, was carried out.

Tank A was dosed on the first day with the normal dose according to the Harold-McKibbin method, and was left standing covered for twenty-four hours. At the end of that period tank B was dosed with the same amount of ammonium chloride, but a reduced amount of water sterilizing powder in order to give it the same amount of chlorine as was found in tank A after twenty-four hours. Both tanks containing the same amount of chlorine were then inoculated with five millilitres of a saline suspension of *B. coli*, made as in the first experiment. Fifty millilitre portions from each tank were inoculated into MacConkey's broth every fifteen minutes for three hours, and after two days' incubation the results were noted.

The initial chlorine content of the two tanks was 0·75 in tank A and 0·8 in tank B, while the porportions at the end of three hours were 0·55 in tank A and 0·60 in tank B.

It took three hours to kill the organisms in tank A (the stale ammonia-chlorine) and two and a half hours to kill them in tank B.

These results show that there is very little difference in sterilizing power between ammonia-chlorine twenty-four hours old and freshly made ammonia-chlorine. Any retardation of the rate of killing after standing twenty-four hours is more likely to be due to deviation of the chlorine in the ammonia-chlorine and to the change in the ratio of ammonia to chlorine. The lower the ratio of chlorine the slower is the action.

Discussion of Results.

The object of these investigations was to determine what are likely to be the worst conditions as regards alkalinity and pollution in natural waters and to find how these conditions affect the sterilizing action of ammonia-chlorine by the Harold-McKibbin method.

The results obtained show that the only waters to be feared are those containing abnormally large amounts of magnesium carbonate in solution. As these waters only occur in very few areas of the Earth their occurrence will be most uncommon. Their source will inevitably be a deep one and they will only occur in springs and wells, which are usually free from serious pollution. When the water reaches a river where it may receive pollution, its alkalinity will be reduced by solution of carbon dioxide from the air and also by any pollution it receives, owing to the buffering action of the polluting agent.

On searching the literature, especially books describing India and Persia, no mention is made of the degree of hardness or alkalinity of magnesium waters in those countries. They are merely described as bitter or saline. Hence, until more is known of the composition of such waters, caution is necessary in any conclusions to be drawn as to the failure of chlorine or ammonia-chlorine to sterilize them.

It is most improbable that any river water in these countries will be found to have a pH value more alkaline than 8·5.

With regard to pollution one can say that if a water contains a stronger concentration of urine than 1 : 5,000, the mixture will be de-oxygenated to such an extent that fish will die, other nuisances, such as smell, will be created, and the water will be obviously unsuitable as a source of drinking water.

A short calculation will show how reasonable is such an assumption. According to the Annual Reports of the Metropolitan Water Board the average person consumes 30 gallons of water a day. As he usually voids about a quart of urine daily, crude sewage should contain a dilution of one part of urine in 120 parts of water. Crude sewage usually absorbs about 30 to 50 parts of oxygen per 100,000 in the Biological Oxygen Demand Test.

When it reaches a river, usually containing one or less parts of dissolved oxygen per 100,000, calculation will show that it must be diluted 50 or 80 times, or it will reduce the dissolved oxygen below 0·4 when fish will die and the river will show signs of pollution.

This is equivalent to a dilution of the original urine of 1 : 6,000 to 9,600, hence a dilution of 1 : 5,000 should certainly show signs of pollution in a river.

Race in "The Purification of the Water of Swimming Baths," Ministry of Health, page 38, is reported to have used a dilution of one part of urine in 5,000 of water, and it is stated that this dosage of contaminating matter was considered excessive. In the same pamphlet Race's results are stated to have confirmed those obtained by Dr. Idzerda, of Utrecht, who used fæcal suspensions.

Taking all these facts into consideration it must be concluded that the worst natural water which one may be asked to sterilize is one having a pH value of 8·5 and a pollution by urine to the extent of one part in 5,000.

As will be seen from the results shown in the tables in this article, the Harold-McKibbin method is quite capable of sterilizing such a water in one hour.

Conclusions.

(1) The greater the degree of alkalinity of a water, the slower is the rate of sterilization by ammonia-chlorine and also by chlorine alone.

(2) Ammonia-chlorine sterilizes most alkaline waters not excessively contaminated with urine. The more acid the water the greater is the degree of pollution that can be dealt with.

(3) The time of contact or the dose of ammonia-chlorine must be increased in grossly polluted and very alkaline waters. As between three and four parts of ammonia-chlorine per million do not cause taste troubles, the standard dose may be nearly doubled if required. Chlorine alone in such a dose would inevitably cause taste troubles.

(4) It is reasonable to conclude that ammonia-chlorine will render safe any water likely to be chosen for drinking purposes.

In conclusion I wish to thank Colonel W. Brooke Purdon, D.S.O., O.B.E., M.C., Professor of Hygiene, Royal Army College, for permission to forward these results for publication, and I thank Colonel G. S. Wallace, O.B.E., and Major F. Harris, M.C., Assistant Professor of Hygiene, for valuable help and suggestions.

MALARIA IN INDIA: THE SYNTHETIC DRUGS AND THE RELAPSE RATE.

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(Continued from p. 17).

SEASONAL INCIDENCE OF MALARIA CASES.

It might possibly be argued that the low relapse rate shown in the preceding tables is not a new occurrence: that the decline in the number of admissions for malaria which has taken place in the last few years is due to other causes such as the cumulative effect of anti-mosquito work, exceptionally favourable climatic conditions, etc.; and that the apparently low percentage of relapses is incidental to the general improvement which has taken place.

To test this argument, the question has been approached from another angle.

As a general rule, most primary attacks of malaria occur in the second half of the year (July to December) and relapses from these cases occur in the following January to June. It is fully realized that there are exceptions to this arbitrary rule. Relapses can, and do, occur in the July to December period. Similarly, "delayed" cases not infrequently make their first appearance in the early months of the year; and fresh cases are common in June, are occasionally found in May, and in certain parts of India may occur all the year round. Nevertheless, a comparison of the relative numbers of cases occurring in the July to December period and in the January to June period affords valuable information.

If the reduction in malarial incidence is due to the general causes mentioned above, and not to a decline in the relapse rate, the relative proportion of the cases occurring in the July to December and the January to June periods will remain unaltered, irrespective of the total number of cases. If, however, the decline is related to a decreased number of relapses, the January to June cases will form a smaller proportion of the July to December cases than in former years. This decrease will not, of course, indicate the true reduction in the relapse rate, partly because of the inaccuracies in the comparison which have already been mentioned, and partly because the July to December figure will also be lowered by the occurrence of fewer "short term" relapses.

The figures from which the following tables and graphs are compiled

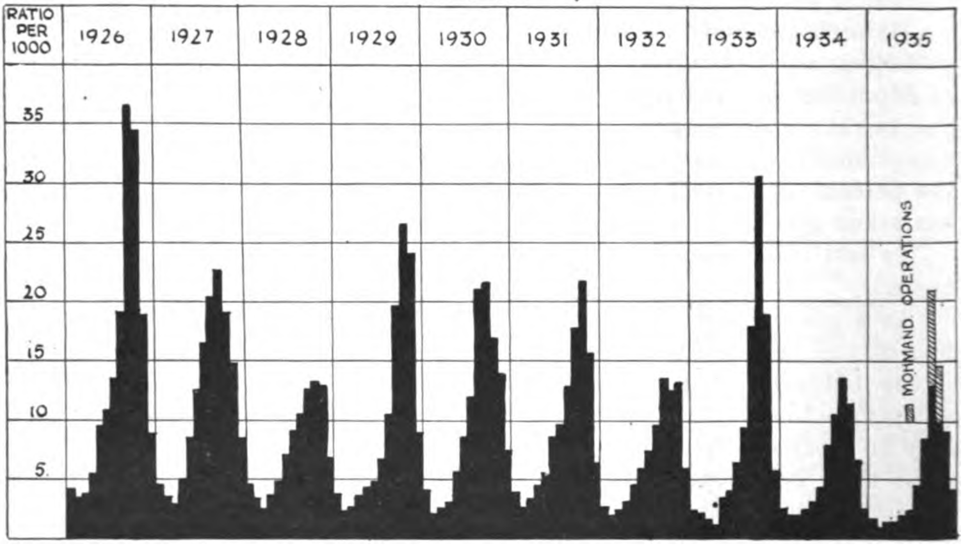
are taken from the monthly returns of hospitals which, for this purpose, are both convenient and sufficiently accurate.

Graph II shows the incidence of malaria, by months, for the last ten years. All admissions to hospital for every type of malaria, whether fresh or relapse, are included.

This graph shows a tendency towards a lowering of the peak of the annual wave, which feature is, however, by no means constant. For example, in 1933 there is, in October, a higher admission ratio than in any one month since 1926. This was the consequence of unavoidable exposure to infection during the Mohmand-Bajaur operations; and was also related

GRAPH II

INCIDENCE OF MALARIA IN BRITISH TROOPS, BY MONTHS, FROM 1926 TO 1935



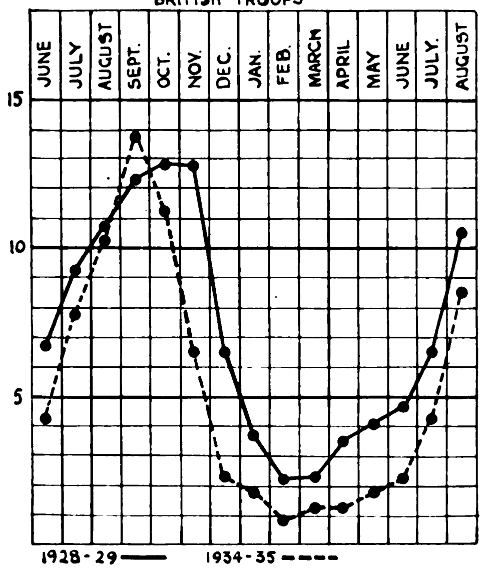
to an epidemic wave of malaria which occurred among the civil population of the north-western quadrant of India at that time. Nor are the low peaks of 1932 and 1934 in any way unique, as a still lower level was reached in 1928.

Of recent years, the most important difference is to be seen in the trough of the wave. This difference can best be appreciated by comparing the trough which followed the climatically "good" year, 1928, with that which followed the climatically "indifferent" year, 1934. (See Graph III.)

In 1928, as the result of severe and widespread drought, mosquito breeding was reduced to an extent which is never likely to be equalled by the usual routine anti-malaria field measures. In 1934 climatic conditions, averaged over the whole of India, were more or less inimical to a good malaria year.

From the superimposed curves of these two periods, it will be seen that, in 1928-29, there was a fairly rapid rise, a sustained peak, a moderately rapid defervescence, and a well-marked rise from April running into the fresh cases of 1929: while in 1934-35 the peak was much

GRAPH III
COMPARISON OF MALARIA INCIDENCE IN
1928-29 AND 1934-35
BRITISH TROOPS



sharper, the defervescence more rapid and to a lower level, and there was a much flatter curve until the rise began in July. A decrease in the relapse rate in 1934-35, as compared with that of 1928-29, would afford a complete and satisfactory explanation of the difference of the two curves, and there can be little reasonable doubt that this is, in fact, the correct explanation. The standard treatment in 1928 was quinine alone, given in intensive and protracted courses.

In Table XII the same facts are shown in a slightly different way. An admission ratio is calculated for the July to December period of one year,

TABLE XII.—MALARIA CASES OF THE JANUARY TO JUNE PERIOD SHOWN AS A PERCENTAGE OF THE CASES OCCURRING IN THE PREVIOUS JULY TO DECEMBER.

	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35
All-India	31·8	24·7	28·4	24·1	22·9	16·8	16·9
Northern Command ..	23·1	24·6	23·6	20·3	21·3	9·8	10·9
Rawalpindi District ..	22·8	19·5	21·6	21·9	20·6	14·8	6·3
Peshawar District	19·9	18·5	24·3	18·3	14·9	6·3	3·7
Western Command	22·3	9·3	44·5	29·4	22·0	26·2	13·5
Eastern Command	38·3	24·2	27·9	21·6	17·0	17·4	18·6
Southern Command ..	40·9	29·0	38·0	31·5	33·0	25·7	27·4

and another for the January to June period of the subsequent year. The latter is then shown as a percentage of the former.

Of these figures the most reliable are those relating to "All-India." Where smaller numbers are involved, errors of considerable magnitude can be introduced by the departure during the trooping season of heavily infected regiments, and their replacement by others fresh from home. A similar fallacy arises through the transfer of units in different Commands from malarious to non-malarious stations and vice versa. In the "All-India" figure these factors are more or less constant from year to year.

It will be seen that, until 1932-33, the figures showed little variation; but in 1933-34 and 1934-35 there was a well-marked decrease. It was from the beginning of the malaria season of 1933 that standard treatment with atebrin-plasmoquine or quinine-plasmoquine became universal.

The figures of the Northern Command are similar to those of "All-India," but the drop from 1933 onwards is more marked. Owing to climatic conditions, malaria in Rawalpindi and Peshawar Districts follows the seasonal incidence postulated above more closely than elsewhere in India[1] and a very marked decrease in the ratio has taken place. In the last two years, the exchange of units in these two districts has not been such as to affect the incidence of attacks in the January to June period.

In the Southern and Eastern Commands a similar tendency can be seen; but in both of these areas (particularly Southern Command) primary cases are fairly common in May and June, and the comparison is, therefore, somewhat vitiated. The position in the Eastern Command is further complicated by the fact that experimental courses of treatment, as described above, and not the standard courses, were used in three important stations which provide almost a half of the malaria cases in the Command.

In the Western Command the number of troops is approximately that of a district. The effect of changing over a regiment is considerable, and can be seen here and there—as, for example, in 1929-30, when a heavily infected regiment departed and was replaced by one fresh from home. Here, also, primary cases are relatively numerous in May and June in those years when climatic conditions are favourable. Hence, the drop in 1934-35 is of no particular significance, except for the fact that it coincides with a similar state of affairs elsewhere in India.

Taken as a whole, and in spite of various fallacies, this comparison of the January to June incidence of malaria with that of the preceding six months affords strong corroborative evidence of a decline in relapses in the last two years.[2]

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[1] The same applies to Kohat and Waziristan Districts; but the number of British troops in these districts is too small to give reliable figures.

[2] This observation was first published in the Annual Report of the Public Health Commissioner with the Government of India, for 1933, Vol. II, pp. 24-26.

HISTORY OF THE MALARIA TREATMENT CENTRE.

The evidence afforded by the history of the Malaria Treatment Centre has already been cited elsewhere, but will bear repetition, as it is a matter independent of statistics and of the criticisms to which statistics are always open.

In 1924 a Malaria Treatment Centre, with hospital accommodation for 30 cases and ordinary accommodation for 200 convalescents, was opened at Kasauli with the double object : (*a*) Of allowing relapsing cases of malaria to recuperate in a salubrious climate ; and (*b*) of concentrating intractable malaria cases in a station where there was no chance of reinfection and where, in consequence, the results of various forms of treatment could be accurately assessed. It was at the Malaria Treatment Centre, after various trials, that the present quinine-plasmoquine and atebrin-plasmoquine courses were worked out.

The number of cases admitted to the Malaria Treatment Centre is as follows :—

1928	..	243
1929	..	248
1930	..	241
1931	..	126
1932	..	63
1933	..	51

During 1932 and 1933 circulars were issued urging hospitals to send all suitable cases to Kasauli, as there was no wish to close the Centre but, on the contrary, a desire to investigate certain further lines of treatment. These measures were of no avail for the simple reason that suitable cases did not exist, and it was reluctantly decided to close the Malaria Treatment Centre in March, 1934.

It can be seen from Tables V and VIII that the decrease in chronic relapsing cases has continued.

RELATIVE PROPORTIONS OF BENIGN AND MALIGNANT TERTIAN MALARIA.

A decrease in relapses might arise from a change in the variety of malaria, i.e., fewer benign tertian and more malignant tertian cases—the latter being much less liable than the former to relapse between January and June. As can be seen in Table XIII—in which the incidence of malignant tertian malaria is shown as a percentage of the total benign and malignant tertian cases reported in the same year—annual fluctuations have occurred, but no progressive change has taken place.

TABLE XIII.—MALIGNANT TERTIAN MALARIA SHOWN AS A PERCENTAGE OF THE TOTAL BENIGN AND MALIGNANT TERTIAN MALARIA OCCURRING IN THE SAME YEAR.

1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934
18·7	20·2	17·9	13·2	12·8	14·8	12·1	14·1	27·1	15·8	17·6	22·7	27·4	19·6

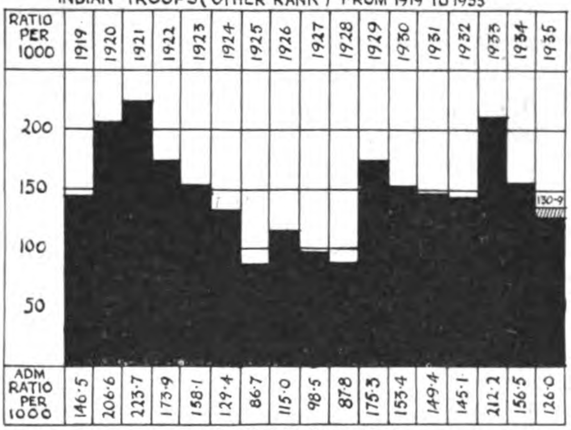
DISCUSSION.

From the evidence contained in the foregoing paragraphs, we consider there can be no reasonable doubt that, in recent years, there has been a decline in the relapse rate which has improved the malaria figures: directly, by lessening the actual number of admissions; and indirectly and cumulatively, by reducing the number of cases of the type best adapted for maintaining the chain of infection. In India, however, there is in the civil population such a bottomless reservoir of infection, that the importance of the latter factor is minimised.

The decrease in relapses may be due either: (*a*) To a change in the type of malaria prevalent in India; or (*b*) to the use of the new synthetic drugs.

(*a*) Time will decide whether or not, in the last few years, the type of malaria has undergone a change, presumably through some alteration in the properties of the prevailing parasite. As far as the evidence at present available goes, there is no suggestion of any such change. There is no significant variation in the relative proportions of benign and malignant tertian malaria; and there is nothing to suggest that a material alteration has appeared in the disease as it occurs in the civil population. The same applies to malaria amongst Indian troops, of which the annual admission ratio is shown in Graph IV.

GRAPH IV
A GRAPH SHOWING THE ANNUAL INCIDENCE OF MALARIA (NUMBER OF ADMISSIONS PER 1000 OF STRENGTH) AMONGST INDIAN TROOPS ('OTHER RANK') FROM 1919 TO 1935



MOHMAND OPERATIONS.
THE 1935 FIGURE IS BASED ON THE MONTHLY RETURNS AND IS LIABLE TO BE SLIGHTLY ALTERED BY THE ANNUAL COMPILATION

This graph bears little resemblance to that in respect of British troops (*see* Graph I). There is no gradual decline in incidence and, from 1929 onwards, owing to various factors (of which the occupation by a complete Indian Brigade of the very malarious station of Wana in Waziristan is one) the figures run at a considerably higher level than in the preceding

years. The high incidence in 1933 is caused by infection contracted during Frontier operations in the malaria season of a year in which the disease was epidemic amongst the civil population of this area.

The absence of improvement in the figures of Indian troops—as compared with those of British troops—is related to the leave which is granted each year during the malaria season to approximately a third of the Indian Army. The men go off to their villages, where they are infected or reinfected with malaria, and are treated by "indigenous" methods. They return uncured to their units, and usually relapse a short time after rejoining. This is a universal experience which is commented on annually in the hygiene reports received from commands and districts. There is no reasonable doubt that this affords an explanation of the lack of improvement in the total incidence of malaria in Indian troops; and it goes to show that inadequately treated malaria is just as liable to relapse as ever it was. On the other hand, it is very interesting to note that the ratio of January-June to the preceding July-December cases corresponds very closely with that of British troops (*see* Table XIV) and shows a very similar drop, which coincides with the introduction of standard quinine-plasmoquine and atebrin-plasmoquine treatment in 1933.

It seems probable that, given a few years with no abnormal cause of heavy infection—such as active operations during the malaria season—an appreciable fall in the incidence of malaria in Indian troops will ensue, although the endemic level will remain higher than in British troops because of periods of leave spent in areas of high infectivity.

TABLE XIV.—MALARIA CASES OF THE JANUARY TO JUNE PERIOD SHOWN AS A PERCENTAGE OF THE CASES OCCURRING IN THE PREVIOUS JULY TO DECEMBER (BRITISH AND INDIAN TROOPS).

	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35
British troops	31·8	24·7	28·4	24·1	22·9	16·8	16·9
Indian troops	33·1	19·5	25·1	27·3	23·8	20·4	16·5

No evidence, therefore, is forthcoming to show that the decline in the relapse rate can be explained by a change in the type of malaria.

(*b*) As regards the second possible cause, there is a close relationship between the decrease in relapsing malaria among British troops and the gradual introduction of plasmoquine.

In 1929 and 1930 this drug was used in an experimental way in certain selected hospitals.

In 1931 a limited quantity of plasmoquine was purchased and issued to hospitals all over India, but the quantity available fell short of requirements. The first indication of improvement is seen in the reduction of the number of cases sent to the Malaria Treatment Centre, to approximately one-half its previous level.

In 1932 plasmoquine was available for general use on an "as required" scale, but—in the absence of instructions enjoining its administration in all uncomplicated cases—was not employed as freely as it might have been, and in many cases was given in inadequate doses. Despite this, and without being dependent on unusually favourable climatic conditions, the "All-India" admission ratio fell to a record low level, and admissions to the Malaria Treatment Centre to approximately 25 per cent of what they were in 1930.

In 1933 instructions were issued that standard courses of quinine-plasmoquine or atebrin-plasmoquine (atebrin having now been authorized for general use) should be given to all cases, unless there were direct indications to the contrary. In the autumn of that year, during the course of a malaria epidemic among the civil population, operations took place in the Mohmand-Bajaur country. As a result, high admission rates were returned in September, October, and November; but, nevertheless, the "All-India" figure was remarkably good.

Admissions to the Malaria Treatment Centre fell still further, and it became necessary to close down the Centre.

In the January to June period of 1934 admissions as compared with those of the previous six months showed a lower ratio than formerly had been recorded, and the figures for the whole year—again without being helped by unduly favourable climatic conditions—were 19·7 per cent under those of the record year, 1932.

In 1935 the cases of the first six months again formed a small proportion of those of the preceding July to December; but a further drop in the total admission ratio was frustrated by Frontier operations during the malaria season. In extent, these operations exceeded those of 1933: but in spite of this, the 1935 figure (calculated on monthly returns, and therefore subject to correction by the annual figure based on statistical cards) was only 0·5 per 1,000 higher than the record figure of 1934. Excluding the cases (and strengths) from the troops engaged in the above Frontier operations the 1935 malaria figure was 56 per 1,000, which is 17 per cent lower than that of 1934.

It was originally shown in India, in experiments carried out by Sinton and others at the Malaria Treatment Centre, that the addition of plasmoquine, in small doses, to quinine, in therapeutic doses, provided a form of treatment which had a well-marked action in preventing relapses in benign tertian malaria. This discovery was subsequently confirmed in larger experiments reported by Manifold (1931), and in special investigations such as those conducted by Dixon (1933). At a later date, the Malaria Treatment Centre tried out atebrin followed by plasmoquine, with very similar results.

There seems little reason to doubt, and good cause to believe, that these forms of treatment have been equally successful when applied on an All-India scale. By reducing the number of relapses, they are largely

responsible for the fall in malaria admissions which for the last few years has been in progress.

We are aware, of course, that these conclusions are at variance with the opinion expressed by the Malaria Commission of the Health Organization of the League of Nations. In its report, "The Therapeutics of Malaria" (1933), the statement is made that doses of plasmoquine such as we recommend are "non-effective"; and it is considered that, while the administration of these quantities of plasmoquine in addition to therapeutic doses of quinine (presumably also of atebrin—although this drug is not specifically mentioned) *may* give better results than quinine (or atebrin) alone in preventing relapses, "the proposition can only be described as being paradoxical."

As far as can be gathered, this opinion is based chiefly on the fact that plasmoquine, when used alone, is not effective in the treatment of benign tertian malaria, unless dangerously large doses are exhibited; and on the failure of combined treatment to abolish relapses in a series of cases (number not stated) infected with the Madagascar strain of the parasite. Although it is not mentioned, it appears probable that these were artificially infected cases.

We have no experience with the Madagascar strain of *Plasmodium*, nor of the treatment of artificially infected individuals; but we feel confident that the evidence we have produced clearly shows that, as far as the current Indian strain of *Plasmodium vivax* is concerned, plasmoquine in these doses given with quinine or atebrin, *does* exert an influence in preventing relapses. We suggest that this treatment may have some specific action on that phase of the parasite (which we are not prepared to define) responsible for keeping the infection alive between attacks.

STANDARD COURSE OF TREATMENT FOR USE IN ALL TYPES OF MALARIA.

As the result of correspondence on this subject during the last three years with officers in all parts of India, of conversations and discussions during tours of inspection, and from a close perusal of large numbers of statistical cards, we have formed certain opinions in conformity with the present state of our knowledge regarding the best standard course of treatment for use in India. It is thought that these may be of sufficient interest to place on record.

The following is a brief résumé of the properties of the three drugs used in the treatment of malaria.

Quinine retains first place in the treatment of the acute phase of a malaria attack. Its action is certain and rapid, and it can be given either by the oral, intravenous or, rarely, by the intramuscular route, according to the circumstances of the case. It has certain disadvantages: its power to prevent relapses of benign tertian malaria is limited: it has little or no

action on the gametocytes of *P. falciparum*; and from the patients' point of view it is unpleasant to take, and even in moderate doses may give rise to disagreeable—if harmless—symptoms.

Atebrin is in many instances as efficacious as quinine in the treatment of the acute stage of malaria, but in a proportion of cases its action in preventing pyrexial attacks is somewhat delayed. This is a matter on which there are diverse opinions, but the volume of evidence to the above effect cannot be disregarded. On the other hand, the action of atebrin in destroying the parasites is, in the long run, probably more potent than that of quinine. Its relapse-preventing properties, as far as can be judged from a limited series of cases investigated at the Malaria Treatment Centre, are not of a high order; nor has it any specific action on gametocytes of *P. falciparum*. It is easy to take, and produces no unpleasant symptoms. The yellow coloration of the skin which occasionally results from its use is transient, and of no significance.

In 1935 a new preparation of atebrin called *atebrin musonate* was placed on the market. This is a soluble drug which is suitable for intramuscular or intravenous administration, and is claimed to relieve all symptoms in a a very short time. Trials have been made with this drug, and while preliminary reports are encouraging, our experience is too limited (only a few hundred military cases having been treated) and too short from the follow-up point of view, to permit us to express a definite opinion on the above claim.

Plasmoquine has been used by us only in conjunction with either quinine or atebrin, so that we are unable to comment on its action when given alone. Our experience shows that when given in combination with these other drugs, as laid down in the standard courses detailed above, it has a well-marked action in reducing the relapse rate in benign tertian malaria. Its property of destroying the gametocytes of *P. falciparum* is well known.

In the vast majority of cases plasmoquine produces no unpleasant symptoms when given in the dosage recommended (0·03 gramme per day for British troops). In the event of abdominal pain or cyanosis making its appearance, cessation of treatment for a day or two produces in most cases a speedy return to normal.

Hæmoglobinuria, and signs and symptoms to all intents and purposes indistinguishable from blackwater fever have, in rare instances, followed the use of plasmoquine among Indian troops; but whether *post hoc* or *propter hoc* is a moot point. A series of cases has already been reported by one of us,[1] and subsequent experience has confirmed the conclusions then formed, viz. that some unknown and unusual factor, acting in conjunction with plasmoquine in the presence of the malaria parasite, has

[1] JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, lii (1934), pp. 178, 269, and 318; *ibid.* liv (1935), p. 100.

existed in each case. Since the adoption of the dosage of plasmoquine now recommended, only one fatal case has occurred in the British Army in India.

In our experience there is nothing to suggest that the toxic properties of plasmoquine are enhanced when it is administered after a course of atebrin.

Based on these observations, and on results obtained in certain hospitals, we recommend routine treatment as follows :—

As a first step active purgation should be ensured, preferably by calomel followed next morning by Epsom salts.

Quinine should be used in the treatment of the initial febrile attack. It should be administered according to the circumstances of the case in the approved fashion, i.e. orally where practicable, and intravenously where immediate intervention is necessary. While the intramuscular route has its advocates in certain cases where the oral route is not practicable (e.g. in the presence of persistent vomiting), it is not a method which we recommend.

As soon as the initial febrile paroxysms have been controlled, quinine should be stopped and replaced by atebrin, 0·3 gramme daily for seven days. Thereafter, plasmoquine 0·03 gramme should be given daily for five days.

If any signs and symptoms of poisoning supervene, the drug concerned should be withheld until all traces of toxicity have disappeared.

It may be said that this is "blunderbuss" treatment, and unscientific in its conception. We do not think so. It is an established fact that the properties of the three drugs differ in detail, and the proposed course is designed to make the best use of the special qualities of each. The treatment has the advantage of being equally applicable to all types of malaria. It gives a free hand to the man-on-the-spot during the febrile stages of the disease when individual treatment is necessary, and imposes restraint only in respect of what may be regarded as "sterilizing treatment," in which atebrin and plasmoquine are given to complete the destruction of the parasite and prevent subsequent relapses.

It may be asked why, instead of being replaced by atebrin, quinine should not be used throughout, thus making a course of seven days quinine followed by five days plasmoquine. There are two reasons. The first is that it has been found (see *ante*) that such a course is not so efficacious in preventing relapses as the atebrin-plasmoquine course. Possibly the administration of quinine over a longer period would have a better effect, but, other things being equal, it is obviously desirable to shorten the treatment as much as possible. The second reason is that atebrin is much more pleasant to take, both as regards the actual swallowing of the drug and the absence of after-effects. Many patients taking even moderate doses of quinine have ringing in the ears and a general feeling of being "below par." Atebrin-treated patients have no such discomforts, and in consequence recuperate rapidly.

Again, it may be asked in what respect this course is preferable to the fourteen-day quinine-plasmoquine course used in certain areas. The answer lies in the fact that it is applicable to *every* case of malaria, while the quinine-plasmoquine course requires modification in all cases which are not quite straightforward. A further advantage is that it involves the use of considerably smaller doses of plasmoquine, the one drug of the three in which the margin between the therapeutic and the toxic dose is known to be small.

The omission of preliminary quinine is a permissible modification in certain mild cases, but it is very difficult to say which cases will be controlled readily by atebrin and which will not. On the other hand, we know that the vast majority of cases are quickly rendered afebrile by suitable quinine treatment.

Some clinicians recommend an interval of two to three days between the stoppage of atebrin and the beginning of plasmoquine treatment, the object being to ensure that most of the former is excreted before the latter is given. This idea is founded on the assumption that the toxicity of plasmoquine is enhanced in the presence of atebrin. We have been unable to find any confirmation of this assumption, and are of the opinion that the introduction of an interval lengthens the course unnecessarily.

Diet and nursing are of great importance. Diet should be fluid during the febrile stages, being increased after the fever subsides, but kept light and nutritious throughout. The cellulose-free diet once recommended to accompany atebrin treatment seems to be an unnecessary refinement. The patient should be confined to bed until the completion of the atebrin course—i.e. for eight to ten days after admission. During the plasmoquine course the patient should be allowed up for increasing periods, so that he can be discharged from hospital at the end of the course sufficiently fit to return to his unit. This régime involves a stay in hospital of at least a fortnight, which, in our opinion, is a minimum period. There is no doubt that thorough rest along these lines does much to render treatment more efficacious, and that it is short-sighted policy to reduce the stay in hospital.[1]

In the final stages tonics such as iron and arsenic may be given if necessary.

In conclusion, we would emphasize that, as the statistics on which our findings are based are drawn from British troops in India, so the recommendations we make apply only to those who enjoy the same amenities, and do not apply to an impoverished population living in a malaria-ridden locality.

[1] In this connection attention is drawn to the results recorded in an article entitled "A Study in Malarial Relapses in the United States Army," published in the *American Journal of Hygiene* (1933), xvii, No. 1.

SUMMARY AND CONCLUSIONS.

(1) There has been a decrease in admissions to hospital for malaria among British troops in India during the last few years.

(2) As far as can be determined this has no obvious direct relationship to favourable climatic conditions or to anti-malaria work or to any other factors of a like nature which affect the incidence of infection.

(3) Statistics are given showing that a decline in the relapse rate has occurred, and it is considered that this is the cause of the decrease in admissions.

(4) This decline runs *pari passu* with the introduction of plasmoquine.

(5) A relatively short atebrin-plasmoquine course of treatment has given very good results.

(6) A slightly modified standard course of treatment is outlined and recommended.

(7) These figures and conclusions refer to a specific community, namely British troops in India living under existing conditions.

We have to thank Major-General E. A. Walker, C.B., K.H.S., Director of Medical Services in India, for permission to make use of the statistical resources of the Medical Directorate and to send this article for publication.

Our thanks are also due to the clerical staff of the hygiene, pathology, and statistical section, and particularly to the Office Superintendent, Mr. G. A. Davies.

The use of the synthetic drugs in the Army in India was initiated by our predecessors, Colonel H. H. A. Emerson, D.S.O., and Major (now Brevet Colonel) J. A. Manifold, D.S.O.

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[*Note.*—We have intentionally refrained from quoting any references other than those directly connected with the treatment of malaria in the Army in India.]

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SPINNING FOR MAHSEER.

By Major E. F. W. MACKENZIE, O.B.E., M.C.,
Royal Army Medical Corps.

There is, in India, a very large number of enthusiastic anglers and of all fish the one most eagerly sought is the mahseer. The "mighty mahseer" is in every sense of the word a game fish and to him must be given the honour of providing the major part of the sport enjoyed by fishermen in India. He has been handed down from the old books as an immensely powerful fish and one to be feared by any angler not furnished with the heaviest of rods and tackle. As a result it has become the practice with the great majority of those who seek sport among the fast flowing rivers of Northern India to employ, when in pursuit of this fish, a powerful and heavy 11 or 12 foot spinning rod, a line with a breaking strain in the neighbourhood of 40 pounds, and specially mounted spoons the treble hooks of which are guaranteed to resist the crushing power of the mahseer. Within recent years the tackle employed for salmon, and for the matter of that for trout also, has undergone a revolution and the old 18 foot salmon rods and 12 foot trout rods are now relics of the past. The adoption of the modern light rod has undoubtedly greatly increased the pleasure of angling, the skill required in the taking of fish and possibly also the number of fish taken, for, in comparing present-day baskets with those of two decades ago, the hard flogging to which the accessible waters in Britain are now subjected must be kept in mind. The introduction of the stationary drum reel and the thread line for game as distinct from coarse fishing, for which it has long been in use, and the greased line method of salmon fishing so ably evolved by the late Mr. A. H. E. Wood have, moreover, enabled salmon and trout to be taken under conditions in which, before their employment, the wisest angler fared not forth.

It will be seen that the methods of angling for salmon and trout have greatly improved of recent years. Can the same be said of methods commonly employed for mahseer fishing in India?

In many of the smaller streams and in slowly running open waters such as canals these fish are commonly taken on fly or on various baits. Under these circumstances it is necessary and usual to use fine gut and for this reason light rods and tackle have become the rule rather than the exception. While such methods are most suitable for certain localities the majority of fish are taken on spinning baits in what may, perhaps without offence, be termed the more sporting waters of the large and fast flowing rivers. On such waters it is unusual to encounter an angler equipped with tackle differing in any essential particular from that used by the pioneers of a generation ago.

What is the reason for this adherence to old methods peculiar to the

mahseer fisherman ? May it not be attributed to the somewhat legendary accounts of the tremendous fighting power of this fish and its ability to crush any but the strongest hooks specially manufactured from the heaviest gauge wire? These attributes have been handed down from book to book and are accepted by the majority of anglers possibly because there is no modern book on mahseer fishing written by an unbiassed angler experienced in all kinds of fishing. The mere acceptance of such hooks as necessary involves the use of heavy tackle since no light rod and line is capable of driving them home and the use of light tackle in conjunction with them would merely lead to the missing of fish after fish. Even on the heaviest gear the number of fish lost is out of all proportion to the number struck, and this in spite of the fact that the mahseer has a toothless mouth of tough leathery skin simply made for hooking and holding. Added to this he takes with a great dash and, given a reasonable chance to do so, almost invariably hooks himself. He can crush hooks and even spoons when hooked sufficiently far back for the powerful pharyngeal teeth and crushing pads to be brought into action. This armoury is situated well down in the pharynx about the level of the posterior margin of the preoperculum and in my experience it is only on very rare occasions that a fish is hooked sufficiently far back for such a situation to arise. Even supposing that I have been unusually fortunate, the number of fish lost through the crushing of spoons or hooks must be negligible compared to the very large number hit and missed through the use of very heavy hooks and tackle, which would undoubtedly have been taken on lighter gear.

This crushing of hooks is, furthermore, practically confined to large fish and the use of the heavy tackle considered necessary to deal with them has brought about a feeling that smaller mahseer are scarcely worth bothering about. This is by no means the case and a fish of 10 or 15 pounds taken on suitable tackle frequently puts up a more spirited if not a longer fight than does one of 40 pounds or more.

As regards the fighting qualities, it must be remembered that the mahseer is normally taken in fast and frequently heavy water and that, unlike a salmon, his first rush is almost invariably down stream. Any uncontrolled attempt to check him then spells disaster as it would do with any other game fish under similar circumstances. Once this rush is over he is soon brought to gaff, except only in the case of very large fish which fight slowly. Why, therefore, should not the mahseer be taken on light tackle equally as well as the salmon or any other game fish? This was my line of thought after several years of swinging a very heavy rod, missing many more fish than I hooked and nevertheless landing certainly not fewer than others fishing the same water. After careful consideration of all the facts available I came to the conclusion that special heavy tackle was unnecessary and that greater pleasure and possibly increased sport might result from a change over to lighter tackle. The result more than justified my most sanguine expectations.

Practically every fish which offers is now hooked and in two seasons' fishing only one fish of some hundreds landed has been lost through a break and that the result of bad management.

The gear recommended is firstly a 10 to 11 foot spinning rod not more than 18 ounces in weight and with an easy action. Any good make of spinning reel to balance the rod is suitable provided it is fitted with a smoothly acting accessory brake the wearing parts of which can easily be replaced.

This is most important as will be explained later and it is in the lack of such a brake that most otherwise satisfactory reels fail. The line should be preferably of silk, but braided linen is cheaper and satisfactory if the greatest length in casting is not demanded. A breaking strain of 14 to 17 pounds is ample provided the line actually has that strain under test. I personally start the season with 150 yards on the reel and have up to the present found this more than sufficient though I would not advocate the use of less. Ordinary spoons of a size and weight usually employed are satisfactory provided they can be fished on this tackle.

It was here that the first difficulty was encountered. A spoon of over two inches of the usual hog-backed or spoon shapes offered too much resistance in heavy water and the light tackle precluded the use of sufficient lead to fish deep. This difficulty was surmounted by the use of long narrow spoons varying in width and weight according to the weight of the water. These are easily sunk to any depth, spin well if correctly shaped and offer little resistance.

All spoons, irrespective of size are mounted with two No. 8 trebles, ordinary gauge wire, in tandem on a flying mount. For preference I use a single wire trace of medium killin wire, not for greater strength, but because sufficient strength is obtainable in a gauge of wire which is to all intents and purposes invisible. One hears of many mahseer lost through broken steel traces and these cases are frequently advanced as evidence of the great power of the fish. This is in no way the case. It is quite impossible to break a sound steel trace with any rod of reasonable power and breaks are invariably due to either a kink or a spot of rust. Therefore keep your roll of wire well oiled and renew your trace however slightly it may be damaged in landing a fish. This occupies no more than two or three minutes as no soldering is necessary. The fall of the wire need only be twisted eight or ten times round the standing end to make a neat and perfect join to spoon or swivel. Be careful also to ensure that the spoon is heavier than the lead to avoid kinks in casting.

To deal now with the accessory reel brake. All the old books emphasize the necessity for a free-running reel and the certainty of disaster if a mahseer is checked during its first dash down stream. As a result it is a common sight to see a mahseer of less than 10 pounds tearing away down stream, completely out of control until such a length of line has been taken that any change in direction on the part of the fish inevitably results in the

line fouling weed or boulder and a consequent break. This seems to me to account for as large a proportion of lost fish as does undue excitement on the part of the angler.

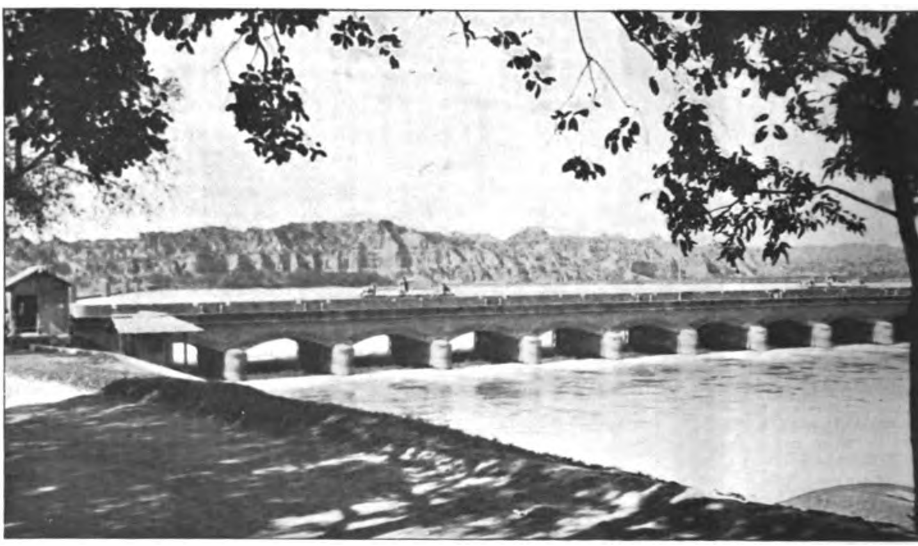
The judicious use of a brake results in such a fish being checked in less than half the distance and in the fish being constantly under control. The run of even the largest fish can be modified in similar degree with perfect safety provided the brake is smooth and nerves are kept under sufficient control to permit of a strain suitable to the strength of the tackle being employed. The easy-actioned rod makes this easier than is the case with the short stiff rod so frequently seen.

A very large mahseer taken on light gauge No. 8 treble hooks.

With the tackle and methods described above and fishing in several of the largest rivers of Northern India I have never yet broken in a fish although a few were lost through the straightening of poor quality hooks before a supply of known temper was received. Not only can the largest fish be taken, as is proved by the landing of an eighty pounder in very heavy water within fifty yards of the place where it was hooked, but all fish from four pounds upwards can be consistently hooked and give excellent sport whereas on heavy gear the smaller ones are not worth catching. A

great deal of sport and pleasure is thus added to the day. A number of anglers who have not tried the method argue that in a place where the fish cannot be followed a big one cannot be held against a heavy stream. The answer is that tackle which enables this to be done destroys the science and art of angling, detracts from the number of fish taken and may never be necessary. As well use a powerful hand-line on which the fish can be hauled out. On many miles of water on small and large rivers I have only once encountered a place where I knew I could not deal with a large fish and which I particularly wanted to fish.

I fished it and took several fish up to ten pounds with greater satisfaction than I would have derived from hauling out one monster on heavy tackle. As the monster did not materialize the advantage lay still further with the light tackle. In water where it is essential to follow a fish other



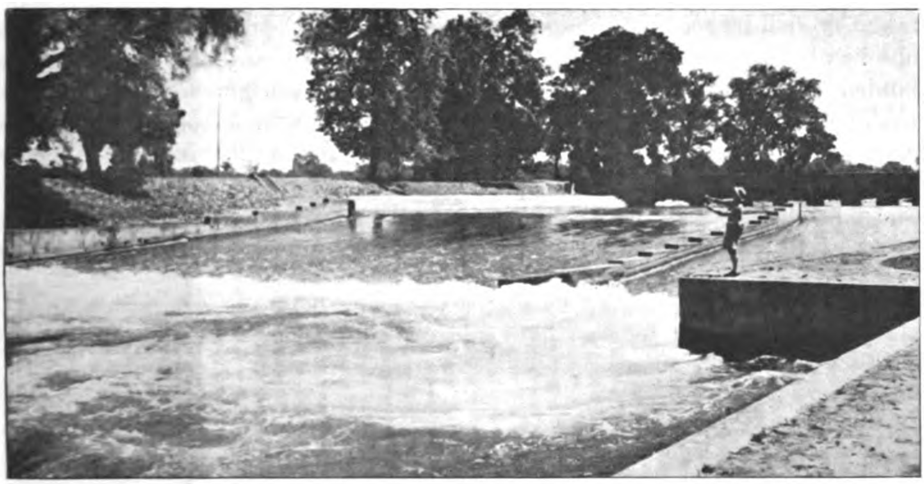
River Sutlej, Sirhind Canal, Headworks. Mahseer lie in numbers in the fast water coming through the regulators and can readily be taken on light tackle.

than along the bank this can be done by employing a surnai or raft of inflated skins which also provides a readily available and delightful means of proceeding downstream from pool to pool.

A further advantage of the type of rod recommended lies in the fact that it can, especially if provided with a somewhat longer spare top, be used for fly and fly-spoon. I have made a most useful spinning rod of the type required by cutting off a few inches from one top of an old grilse fly rod.

Only one other type of outfit then remains for the complete mahseer fisherman in Northern India, namely the stationary drum reel and thread line rod. This outfit was at first regarded by mahseer fishermen with amusement but is now being used by an increasing number of anglers in Northern

India though its use appears to be largely confined to the smaller rivers. There is no reason why this should be the case and I constantly use it on large rivers such as the Sutlej and Jumna. In view of the somewhat heavy baits required I would recommend the salmon size reel. My own outfit consists of such a reel and a 7 foot split cane rod weighing 5¼ ounces. The reel is filled with over 100 yards of 7 pound silk line but I would recommend 9 pounds for the beginner. A 7 foot length of 9 pound artificial gut spliced to the end of the silk line minimizes the wear in casting. A trace of artificial gut of 7 pounds is satisfactory and spoons up to 2 inches can be fished. My spoons are mounted with two fine wire trebles on a flying mount, No. 13 for small spoons, No. 11 for larger. These minute hooks sink into the fleshy mouth or lips and never let go. I will not attempt here to describe the method of fishing with this outfit since all I could say has been more ably set forth by Mr. Alex Wanless in



Western Jumna Canal. Many mahseer have been taken from this fast water on thread line.

"The Angler and the Thread Line" and subsequent books published by Messrs. Herbert Jenkins. Suffice it to say that the method is eminently suitable for mahseer fishing, gives greater sport in the running of a fish than any other and enables fish to be taken in conditions under which they can be moved by no other method of spinning that I know. It must be understood that a fish of any size cannot be held in a stream and it is therefore necessary that the angler should be able to follow his fish for a reasonable distance by some means or other.

I have found, on the other hand, that a mahseer is, for some reason or other, less liable to go off with his characteristic rush when hooked on this tackle and that, if all strain is thrown off when the fish is considered to have gone far enough, a manœuvre which the mechanism of most reels permits, it almost invariably stops and allows sufficient line for safety to be

recovered if this be done carefully and in a manner not calculated to alarm the fish.

I have now successfully landed a large number of mahseer up to 15 pounds on this tackle with only one break and that due to gross mismanagement on my part. The sport in taking them has been incomparably greater than would have been the case on any other tackle. The 15 pound fish was taken in a heavy stream on the Jumna at a point where the river is over 100 yards wide. It crossed the main stream three times and was easily enticed back by careful handling, being killed in about fifteen minutes. It was necessary to land it on a steep gravel bank swept by the stream and this was accomplished without difficulty, but it is necessary to be sure that the fish is absolutely played out before attempting to hold it and to be sure that the line can run free in the event of its making another plunge. The mahseer's habit of lying quite still while being handled makes it the ideal fish for landing on thread line. I have taken no fish larger than 15 pounds on this outfit only because no larger one has been hooked, but I see no reason why fish of any size should not be landed successfully and in much shorter time than might be expected.

The methods described in this article are not claimed to be either new or original and are practised in part no doubt by many anglers. Nevertheless those one meets by the water invariably employ the older methods and I have been inspired in the writing of this article only by a desire to hand on to others knowledge which has so greatly added to my own pleasure in angling in India.

ROYAL SOCIETY OF MEDICINE UNITED SERVICES SECTION WITH SECTION OF PSYCHIATRY.

DISCUSSION ON FUNCTIONAL NERVOUS DISEASE IN THE FIGHTING SERVICES.

(*Continued from p.* 50).

Dr. E. Mapother: I have no intention of dealing with the conditions under discussion as they occur in peace. My experience of such is limited to a few cases seen during the past year at Millbank. I shall confine myself to cases originating in the Army during the War and refer very little to later sequels.

The problem at once arises whether to be merely reminiscent or to attempt at the risk of absurdity to draw prophetic deductions. I propose to draw such deductions but I am quite aware that all attempts at foresight might resemble that busy preparation for the last war with which it is traditional to charge those who have to get ready for the next.

There seems no disguise in any country about the primary aim of disorganizing civil resources and demoralizing the civil population of the enemy country. It might even prove that the brunt of the next war will be borne by the civilian population rather than the fighting forces; that destruction of civilian morale, communications, and supplies might render engagement of fighting forces on the scale of the last war impossible. It is therefore a large assumption that there will remain either the need or possibility of organizing the sort of provision for functional nervous disease in the fighting forces which might be suggested by experience of the last war. But this assumption seems the only possible basis for constructive proposals.

A second problem which arises is the scope of the term functional nervous disease. It might reasonably be held to include three groups :—

(*a*) Conditions, such as epilepsy, in which it is clear that there is primary disorder of functions in levels of the nervous system below those subserving consciousness but in which the nature of this disorder is obscure.

(*b*) Conditions of grave mental disorder of the type usually termed psychoses.

(*c*) Conditions usually termed neuroses, which in war—even more than in peace —form a large majority. These are the cases in which the intellectual derangement is relatively minor, or at least inconstant, in which the patient retains insight and accordingly is co-operative and needs no kind of restraint, and lastly in which the disturbance is largely due to psychological factors and requires psychological influences of some kind in treatment.

There is a large overlapping between neuroses and psychoses, but the differences, though quantitative, do correspond to the fact that provision is needed for separate treatment of the extremes of the two types.

With regard to these three groups: I propose to say little about the first. The consensus of opinion among neurologists is that war stresses were practically without influence in production of true epilepsy and that any apparent incidence of epilepsy in the fighting forces during the War, beyond that to be expected in a population of the same age-distribution, was due to mistaken diagnosis. I merely refer to this

because it is one example of the fact that many functional cases were disguised under organic diagnoses, including D.A.H., effects of gas, and so on. The true proportion which neurosis bore to the total medical casualties of the War was vastly underestimated in official statistics.

With regard to the psychoses, it seems to be felt by most psychiatrists of experience that the majority of cases which, after becoming overt during the War, later persisted indefinitely as chronic schizophrenia or paranoid states, or recurred almost spontaneously as extreme depressive and manic attacks, would have followed much the same course if there had never been a war.

It remains true that many transient cases of severe psychoses were due to war stress in the same sense as the commoner neuroses and in similar degree. Though I never served in one of the hospitals such as the Lord Derby, which dealt with most of the War psychoses, I saw elsewhere cases of protracted confusion with terrifying hallucinations, stupor, with regression to childhood, and many transient depressive schizophrenic and paranoid states. Profound demoralization in those whose conduct had hitherto been irreproachable occurred commonly both after and without head injury, and often gave rise to very difficult problems.

It was not possible, in their initial stages, to discriminate cases that were mainly constitutional and destined to become chronic from those of which war stress was the main cause and which were due to recover. Moreover many transient states of psychosis were apt to be followed by a long period of anxiety neurosis. During these the patient was much more suitable for association with others neurotic from the first than with those who were still psychotic.

During the Great War the Maudsley Hospital was used as a clearing hospital with carefully classified accommodation, which received patients suffering from neuroses and psychoses of practically all types, and after a sufficient spell of trained observation, distributed each man to another hospital according to his particular type. The enforcement as a universal practice both overseas and in England of the principle that all functional nervous casualties should pass through such a clearing hospital would have been a most useful co-ordinating measure.

For secondary stages of treatment there should have existed free interchange between a carefully classified system of hospitals such as the Ministry of Pensions came to possess.

During the War arrangements were made for early treatment of the severe psychotic cases in special hospitals outside the provisions of the Lunacy and Mental Treatment Acts. Such special treatment should have been continued as long as any considerable hope of recovery remained. In fact, until three years had elapsed, the patient should have only been transferred to an ordinary mental hospital at his own request or that of his relatives. Thereafter it was unpracticable to multiply special hospitals near their home for Service patients who were chronically insane. But it seemed a reasonable demand that separate accommodation should have been provided for those severe chronic cases who desired continued treatment outside mental hospitals and were prepared to waive the question of locality.

Passing from the psychoses to the neuroses, it was possible at all stages to discriminate, by a somewhat artificial process of abstraction, three syndromes as making up the great bulk of so-called shell-shock cases, namely anxiety neurosis, hysteria and neurasthenia. Of these neurasthenia, which is a condition of exhaustion, has

become in relatively pure form the commonest of all in chronic cases. But it was rare in early stages and I shall therefore confine the rest of my remarks to anxiety neurosis and hysteria.

I propose to emphasize impressions and conclusions derived from my own experience rather than to deal with the matter impersonally. On the whole this seems of more value, although, of course, both what one is conscious of having experienced and the conclusions drawn are warped by one's own personality. I must ask for allowance to be made for dogmatism as being partly due to brevity.

During my two-and-a-half years' somewhat mixed experiences overseas during the Great War that of the occurrence of functional nervous disease was almost negligible. It was when I had returned to duty at a Command Depot in England that I first learnt what a problem shell-shock had become. In virtue of pre-war experience at a mental hospital, I was attached to shell-shock hospitals for training, and finally put in charge of two hospitals which formed the neurological wing of the Second Western General Hospital. With this Unit were associated a number of auxiliary hospitals, and I had various other duties in connexion with so-called shell-shock cases, especially Medical Boards.

During a period of nearly two years from my return to England in April, 1917, until demobilization at the end of March, 1919, I personally examined about 1,000 recent shell-shock cases. From August, 1919, to November, 1920, I was in charge of the Maudsley Hospital for the Ministry of Pensions and saw another 700 patients of widely varying types who had lately become pensioners. During the past ten years as consultant of the Ex-Service Welfare Society I have examined over 2,000 candidates for admission to the Society's Homes and have seen at intervals over some months about 1,500 patients sent to these Homes, either by me or from the Provinces. Altogether from first to last I have personally examined nearly 5,000 men suffering from neuroses originating in the War.

It appears to me that the great mass of these exemplify two syndromes, anxiety neurosis and hysteria combined in varying proportions and sequence.

Theoretical discrimination of the two is fairly simple. Determination in practice of the relative proportions of the one to the other in an individual case was of great importance and at the same time very difficult.

Anxiety neurosis was over-excitability of the fear mechanism, showing itself persistently or in paroxysms, in relation either to situations which cause more or less fear in everyone, or to situations which had become conditioned stimuli in the particular individual. It might, of course, develop because the man was specially prone constitutionally, or because he had been subjected to stresses of special severity or duration.

Patients with anxiety neurosis displayed, out of proportion to any immediate cause, not only the mental manifestations of fear but also the bodily signs. Many, in fact most, patients did not display the whole physical picture of fear uniformly. This was one of the great causes of error. When one component of it, such as D.A.H., was outstanding, the man was apt to be diagnosed as suffering from some localized physical condition. Concurrent presence in some degree of the rest of the signs of fear was the clue to the truth in many such cases.

The presence of certain physical signs which cannot be imitated voluntarily was

the best criterion and, in fact, to my mind the *sine qua non* of positive diagnosis of anxiety neurosis. These signs included dilatation of pupils, tachycardia, flushing, sweating, fine tremor, and genuine increase of reflexes. Expert knowledge was required to discriminate from hysterical imitation true increase of reflexes and also true stammer and weakness of station and gait.

Even as to less imitable signs, e.g. tachycardia, flushing, and sweating, I have gradually come (after observation of pensioners confronted with an inducement rather than a stress, e.g. a Medical Board) to believe that the degree in which even these are manifest is capable of higher control according to incentive. Their total absence negatives the idea of any high degree of anxiety neurosis, but their intensity is of less value as positive evidence of severity.

Passing to hysteria, the genesis of this during the War was different from that of anxiety neurosis, although the resulting symptoms might be hard to discriminate. Underlying the development of the overt symptoms or so-called accidents of hysteria, there was in war, as in peace, a varying measure of hysterical character; owing to the strength of incentive during war it was often less important than in most peace-time cases.

The essential genesis of war hysteria consisted in the fact that a man, with little or no more excitation of the fear mechanism than was universal, showed on the other hand much less than normal inclination to higher control of fear (*particularly less willingness to carry out duties which this made disagreeable*) and took refuge in the representation of some disability either physical or mental.

As in all hysteria the symptoms corresponded to the man's ideas concerning some disability and not to anatomy, physiology, and pathology. It was less common than in civil cases to find that the condition was one with which the man had suffered in early life or had then been familiar in one of his family. More often it was an exaggeration and protraction of disease or injury which the man had lately suffered or one which he had seen among comrades. The whole situation was complicated by the fact that anxiety neurosis, either in its general or one of its localized forms was the condition most commonly represented by hysteria and that hysteria might protract anxiety neurosis or even from the first exaggerate it.

Hysteria differed in varying degree from straightforward malingering. To represent the latter as common would be a naive underestimate of the capacity of human beings to believe what is in their interest. This gift made malingering unnecessary. Sometimes there was an initial phase of malingering, but (with or without this) consciousness of the intention and motive to represent the disability was soon suppressed. At the same time the maintenance of manifestations became automatic and showed persistence in a way that would have been impossible by voluntary effort. This applied, for example to hysterical anæsthesia, to purposeless movement and to the spasms that might persist even in fairly deep anæsthesia.

It was equally clear that, given adequate incentive, hysterical symptoms could be quickly, even abruptly terminated by voluntary effort. This became obvious at the Armistice and occasionally even during the War. It indicated a real difference from true anxiety neurosis from which no lasting recovery was swiftly obtainable.

As regards the essential factors of anxiety neurosis and hysteria, I submit that it might be made widely known that both were resultants of three factors in varying

proportions, namely: (1) Fear; (2) team spirit; (3) the recognition of neurosis as a way out of the danger zone and probably out of the Army. As regards fear there is no need to say more than that it was practically universal among those exposed to the experience of modern war.

I use the term "team spirit" for lack of a better. I should share Colonel Heatly-Spencer's objection to any reference to *esprit de corps* as a term likely to lend itself to the type of humour most popular in the Army. Solidarity smacks of Labour politics. I think my substitute avoids all suspicion of ethics and has the merit of referring to one of the only subjects upon which enthusiasm is decent in this country.

To my mind recognition of neurosis as a way out had obvious influence on the incidence. I practically never saw any form of neurosis while I was with Divisional Units in France and Mesopotamia during the first half of the War although other ways out were far from uncommon in my Division. (All foot wounds and those below the elbow had to be retained for investigation by the A.D.M.S.) I remember no neurosis among the casualties I saw after attacks at Loos or those after an attack in an attempt to relieve Kut had failed with heavy losses. Like everyone else I saw none in the surgical wards among the badly wounded. Infection alone was inadequate although trench fever was often an accessory factor in France. In Mesopotamia during the summer of 1916 when fighting had ceased, troops poured down with infections and later in India I saw hundreds of typhoid convalescents. I do not think I was blind to conditions that were obvious to me at the Command Depot among those convalescent after invaliding from France.

A significant point as denoting the influence of repute of neurosis as a way out is the frequency of certain traditional syndromes in the Army even during peace. Among the few cases I have seen at Millbank the number with alleged localized amnesia would exceed those seen in a year at the Maudsley Hospital among a thousand in-patients.

One further point of my experience is related to a general principle of great importance. The tradition of stoicism and of shame about showing fear or distress when in pain, is very differently developed in different races, e.g. it differs among the French as compared with us and from one Indian race to another. This does not necessarily correspond to the degree of willingness to take such risks as are up to a man. What is true racially is true individually. In most battalions there were men who made exhibitions of themselves during periods of waiting, but behaved with magnificent courage when the time came. I think this is relevant to practical problems related to the subject of this discussion. The distinction of neuroses and cowardice raised by the shell-shock Committee has been raised by Colonel Heatly-Spencer. In an ultimate sense it is a metaphysical problem connected with the doctrine of free will, but it may be possible, even necessary, in a more limited way (as in the case of criminal responsibility in civil courts) to frame a definition as a basis of action—and admittedly on the ground of expediency rather than abstract justice. Such action defeats its own ends if flagrantly unjust. Therefore I think it should be recognized that only his failure to accept the risks which are up to a man should be thought cowardice, that apart from this, exhibition of fear should not be punishable, and that the presence in high and lasting degree of the physical signs of fear should be mitigating evidence. Otherwise it becomes largely a question of

by whom he is judged rather than of the facts, whether the consequences are those of cowardice or neurosis. Much the same principle is involved in one's attitude towards hysteria and anxiety neurosis respectively. At least I have always felt that the ratio of firmness to sympathy needed to be larger in proportion as the reaction was hysterical.

This brings me to the practical suggestions which are the point, if any, of my remarks. In war there is some necessary conflict between medical and military views. To me it seems that it has to be recognized that in war everything must be subordinated to the winning of it. In the matter of neuroses this was not sufficiently recognized in the last. That is one of the main reasons why trained regular officers combining sympathetic knowledge of neuroses with the military outlook should be in administrative charge. There are many other minor reasons connected with the maintenance of discipline and the conduct of an orderly room—by no means the least important department in hospitals for neurotics.

I now pass to some notions concerning prevention and treatment of functional disease in war. Under prevention must be considered recruitment, the period of training and handling when in the danger zone. As to recruitment, it is to be hoped that from the outbreak of a major war universal liability to service as required by the State will be enforced without individual choice and that patriotism will not be penalized. Exclusion from fighting units of all those who will certainly be useless will be needed. But it is to be hoped that exclusion will be strictly confined to those with objective signs and that observation will be substituted for the acceptance of a history of subjective symptoms and of medical certificates based on these.

One of the main difficulties of the sane handling of war neuroses was the wave of sentimentality which swept the country—the disposition to regard as heroes all who joined the Army. In a Liverpool paper an account of an epidemic of war babies was followed by correspondence demanding exemplary punishment of the harpies who were sapping the morals of our brave boys in blue—that is, the war neurotics from a neighbouring hospital.

As a whole, of course, the Army was an average sample of the male population, but though the vast majority of war neurotics were decent men who were genuinely disabled, the shell-shock hospitals contained more than their share of men with very little moral sense; this was not only on account of demoralization during the War. The most significant document in many cases was the conduct sheet.

The regular Army in 1914 was a splendidly efficient and disciplined force, but to be frank, it contained a proportion of wasters and half-wits who broke down easily. The first hundred thousand was a sample of the population with, on the whole, immunity to neurosis far above the average, but it contained a proportion of the impulsive who had enlisted in haste and repented at leisure. The recruits of 1918 included many youngsters with physique that would have ensured rejection in 1914, many elderly men for whom the conditions of service in the ranks were a torment, apart from any danger, and an increasing number of those who had succeeded in being indispensable until then.

As to prevention by training for reduced incidence of neurosis, this was mainly the problem of the combatant officers. The creation of the team spirit was of course easier in 1914, when the feelings of the inarticulate many resembled those which found utterance in Grenfell's " Song before Battle " or Rupert Brooke's sonnets, than

in 1918, when they came to be better expressed by Siegfried Sassoon. But at all times the most important single influence determining the ratio of war neuroses was that of the Regimental Medical Officer.

As to prevention when overseas, neurosis was rarest in units whose officers showed real interest in securing for their men any possible comfort or mitigation of hardship and when out of the line knew how to insist on discipline and fitness without annoying men about eyewash.

Spells out of the line on some pretext other than neurosis saved many from crocking, as Colonel Heatly-Spencer has said. No doubt leave to England helped discipline in a general way, but it could not be arranged at the right moment to suit those who were breaking down. So many men took advantage of leave in England to report sick with neurotic symptoms that I think such cases, with rare exceptions, should have been sent back for investigation by an expert Medical Board in France. Some, of course, had good reason in the fact that they had not been able to get a hearing about genuine disability from an unreasonable medical officer, and these needed investigation.

One point of importance is the need to have expert advice from a neuro-psychiatrist readily available in the field. I saw one case where a question of being shot arose because the man habitually slept on duty standing on the firing step and resting his arms and head on the parapet, a perfect mark for snipers—obviously a post-encephalitic at a time when the condition was not known. I saw another man who had been severely punished for repeated failures in his trench duties—a schizophrenic who within five minutes was telling me about the women that seduced him at night.

Treatment of Neurosis when Diagnosed

Without adopting any ethical attitude I think it should be made plain that, as long as those fit for what is required of them have to accept not only risk but revolting conditions of life, inadequacy cannot be regarded as entitling to exemption from unpleasantness during war and from work afterwards.

It is not of course merely a question of the value of the neurotics themselves but bad effects on others when rewards of inadequacy become too obvious. Until the closing months of the War persistent cases of neurosis, after treatment (and in many places after petting), could count on discharge from the Army. Eventually by A.C.I. 712 they were guaranteed against being sent overseas within six months and then only after being examined by a special neurological Board. The Armistice came and nullified all this.

I suggest for discussion the following principles :—

(*a*) There should be no discharge for neurosis in the War and no getting round this by calling it something else. So far as military conditions permit all treatment of neuroses should be conducted overseas and regulated by expert opinion rather than sentimentality. Transfer to England should only be permitted after a special Board. This would involve the establishment overseas of special clearing hospitals, treatment units and convalescent centres.

(*b*) From the beginning the persistent attempt should be made to discriminate and segregate cases of anxiety neurosis and hysteria—that is, those with inimitable

physical signs of fear—and those with signs which, though functional, cannot be so regarded.

Pure anxiety cases needed all the sympathy possible and there was no need to try and hustle them back to duty. The vast majority, until they had been contaminated by contact with hysterics, showed no reluctance to return as soon as was possible. Many were no longer fit for the line but they were prepared to accept the decision made for them. With hysterics it was different. It was almost useless to send them to the line. But without brutality it was possible to find modes of employment that reduced the repute of hysteria as a means of escape from the unpleasant.

Whether at home or overseas, I think fairly simple treatment sufficed for anxiety cases. In the early stages, as in other acute emotional disturbances, patients needed above all physical and mental rest, reassurance, sleep, and attendance to physical needs. Reassurance included convincing the men that they had not progressive insanity and consoling them about failure to live up to their ideals. Later it was necessary to remind them of the continuing obligation still to give such service as they could. Every effort had to be made to discourage hysterical additions to symptoms. Suitable employment was important and recreation of a type that had to suffice for soldiers fit for duty. The amount of leave from hospital should have been limited. It needed emphasis that men were in a hospital, not a hotel. It was advisable that hospitals should be out of towns. Discipline was all important. Even some major hospitals struck critical observers accustomed to overseas discipline as institutes for spoiling good soldiers. No war neurotics should have been sent to V.A.D. hospitals or such places. The condition of those who after having been a year or two at such places were gathered into the Unit of the Second Western General Hospital of which I was in charge, was simply appalling in every way.

Personally I thought very little subtle psychotherapy was called for. Its efficacy was exaggerated. Not the least interesting feature of the total situation was the psychology of the psychotherapists. We, like many others, were so obviously putting up with less than those abroad that we had to feel justified by our works. The account of results as extorted and distorted by representatives of the lay Press smacked of the miraculous. If we had been able to foresee the future under the Ministry of Pensions of those who having obtained their "tickets" stepped so jauntily out of the Army in a new suit of civies we should not have been so complacent.

I think this applied to all forms of intensive psychotherapy. The form of persuasion which consisted in demonstrating to the patient the difference between his symptoms and those of an organic lesion which they resembled was merely tactless. Of course anything sufficed to save the face of some if accompanied by the essential discharge. As to psycho-analysis in the true sense there is no need to discuss it. I believe no one even proposed to investigate the love life of Thomas Atkins from the cradle onwards. The theory of cure by emotional expression had some vogue. I believe it was first suggested by Aristotle, rediscovered by Freud, abandoned by him ten years before the War, and revived and vaguely attributed to him. A variant of the same was the idea of integration—that buried memories had to be rendered conscious and reconciled with the personality. There was some truth in this at times. But generally the memories were not in any real sense buried and emotional adjustment was the whole problem. Such results as I saw were far from uniform and much

less dramatic than those I read about. The *post hoc propter hoc* reasoning played a large part. Some results were definitely bad. One was reminded that in one's student days it was the fashion to open up all foci of surgical tuberculosis and follow up all tracks, scraping them with a sharp spoon, as my teacher said, "like a dog after a rabbit." All that sounded plausible, but it has been abandoned. Perhaps it is time to reconsider the real merits of what one might term psychological rabbiting.

In conclusion, I want to emphasize that neuroses were one of the largest medical problems of the last war, far larger than official figures convey and will probably be so again. Would it not be wise to ensure that there is an adequate supply of regular officers trained to play their indispensable part in the process of dealing with them? I also question whether the number of civilian practitioners ready to supplement those of the regular service in respect of the type of treatment needed is proportionately larger than in 1914.

Wing-Commander H. L. Burton: With regard to the preparations for dealing with cases of functional nervous disease in the event of another war, looking back on my experiences in the formation of a shell-shock hospital at the end of 1914, and on the confusion then existing, I am deeply impressed by the necessity for such preparations to be completed before the outbreak of any future hostilities. Adequate measures cannot be improvised in haste—calling, as they do, for a supply of medical officers experienced in the diagnosis and treatment of these conditions, and of an adequately trained staff. It appears doubtful whether a requisite number is at present available. The needs of the general population in a future war may claim the services of those civilian specialists who would otherwise be available for this duty with the Forces; it follows, therefore, that one essential is the training of medical officers in the subject of the psychoneuroses.

An additional difficulty in planning ahead arises from the uncertainty of the circumstances in which the stresses of future war will be imposed.

An important result of the shortage of trained staff in the early days of the last war was, I think, the liability to errors in diagnosis. There was a failure to differentiate between the organic and functional cases, such as the concussional and emotional types of "shell-shock." Owing to lack of knowledge at the time, various types of nervous disease originating on active service, ranging from G.P.I. to neurasthenia, were at first labelled "shell-shock." Such a label was liable to stick and to lead to indiscriminate application of psychotherapy to unsuitable cases.

There was also at that early period a failure to discriminate between patients who broke down under severe stresses, and those who were constitutionally limited in their powers of adapting themselves even to such a mild stress as that involved by transplantation from their homes to the barrack square. It would have been wiser to post such patients at once to non-combatant units—where they might eventually perform some useful tasks—than to detain them in hospitals for treatment needed by more suitable patients.

I agree here with Dr. Mapother—that under no circumstances should such men be invalided out of the Service, and also as to the need for maintaining strict military discipline in the treatment of these patients. Much trouble was caused by the sentimental attitude displayed in the last war.

The problems before us are: (1) To take steps to diminish, as far as possible, the incidence of functional nervous disease among Service personnel; (2) to ensure the provision of adequate treatment for cases which develop.

The following measures might be taken to prevent the occurrence of psychoneurosis: Firstly, elimination of those predisposed at the time of enlistment. This is a counsel of perfection, but seems hardly practicable. Colonel Heatly-Spencer referred to the Royal Air Force methods in this connexion. They apply to the selection, primarily, of personnel for flying duties. Pilots must be capable of standing the stresses incidental to Service flying which are both psychological and physiological.

Briefly, the method in use comprises a careful consideration of the candidate's past history as regards health, school and athletic prowess, hobbies and habits, also of his family history, together with the application of special physiological tests. This is accessory to a complete examination of the eyes, ears, nose, throat, and general physical condition. No special psychological tests are employed, but the whole examination has such an aspect. The special physiological tests are held to measure the general nervous stability, particularly of the cardiovascular and respiratory systems. It is believed that a satisfactory finding in this respect is usually correlated with a high degree of mental stability which is particularly desirable in view of the highly individualistic nature of a pilot's duties. The standard is higher than that required for ground duties and, owing to the length of time entailed in the examination, would hardly be applicable for general use.

Secondly, education of personnel, to which Colonel Heatly-Spencer referred as a rather remote possibility. I believe something could be achieved by simple explanation to personnel of the psychology of fear, and how its occurrence can best be dealt with.

Thirdly, during the training period of recruits, officers and non-commissioned officers have opportunity for observation of their men, and should be able to weed out those who appear obviously unlikely to stand stress. They could be economically drafted to non-combatant units where they would be less likely to break down.

Fourthly, general measures. I believe that in the Great War factors other than fear played a considerable part in producing breakdowns. The prolongation of the stresses, together with the intense discomfort and depressing effect of surroundings, day after day, with little respite in many cases, together with the feeling in many minds that all this would be interminable, tended to sap the morale of the stoutest in the trenches. Steps to mitigate this outlook merit at least consideration by the executive authorities for application whenever exigencies of duty permit.

Shorter periods of active duty, with rest intervals, that are actually rest intervals, giving opportunities for relaxation, with good feeding, must all tend to maintain morale. Possibly more stress has been laid on the intensity of fear than on the extensity of lesser strains. For instance, the examination of invalids from the Quetta earthquake revealed only a small percentage of very mild psychoneurosis. Here the stress was not prolonged, though intense while it existed.

Turning to the question of treatment: The aims before us are the return of personnel to full duty as rapidly as possible, and the relief of the patient's symptoms. Too often these aims will be in sharp conflict, and to reconcile them is the task of the therapist. There seems to be a need for diagnostic and therapeutic teams.

The diagnostic team should be established near to the scene of active operations. Cases call for expert investigation as early as possible after development—before symptoms have a chance to become firmly integrated—if they are to be successfully treated. The "reflection" period must be avoided. Correct handling of cases in this early stage is likely to make all the difference between rapid recovery and chronic invalidism. The first link in the chain is the unit medical officer. He should have sufficient psychological knowledge to make an early diagnosis and to label a case for evacuation direct to a suitable centre. He alone has the power to supply relevant information concerning the causes of breakdown in each case. Absence of such details in the last war proved a grave handicap to those who were dealing with patients in hospitals. The proforma instituted at a later date proved valuable, and its use should be revived if necessary. At a suitable centre, the diagnostic team should make a preliminary investigation and decide the disposal of each case. Certain cases of a mild nature could be dealt with at rest camps under trained personnel; more serious cases would need evacuation to special hospitals at the base for treatment by the therapeutic team.

Dr. Mapother has already stressed the fact that only severe cases should be allowed to leave the country—supposing that the scene of action is abroad—and that the term "shell-shock" must be scrapped. My own experiences strongly confirm his views. "Shell-shock" proved itself to be a highly infectious disease, and afforded too easy an avenue of escape from duty to those who sought one.

I believe it to be unwise to send cases of war neurosis to the wards of a general hospital. The patients are unlikely to receive appropriate treatment and are apt to languish in happy seclusion for long periods, to their great content. Much organization will be necessary to achieve these ideals. The outstanding need appears to be the training of the necessary medical personnel in the diagnosis and treatment of the psychoneuroses. Until this is carried out I venture to say that we cannot consider ourselves prepared.

Dr. Millais Culpin said that he was first drawn to this subject by recognition of the number of undiagnosed cases in the surgical wards of the home hospitals, and he saw little prospect of more accurate diagnosis in the future.

A distinction must be made between a hysterical state and a hysterical symptom occurring in a patient who might be suffering from, say, an obsessional condition. He had known such a case in which a crude and apparently successful attack upon the hysterical symptom was followed by the suicide of the patient.

As bearing upon the problem of eliminating the unfit man, he would cite the case of deep-sea divers already described to this section by Surgeon Lieut.-Commander Phillips, in which physically picked men suffered from unsuspected phobias which led to the manifestation of fugue states.

He had treated several hundred war patients by the methods of revival and abreaction and was satisfied with his results; though amongst these hundreds were several men in whom a major psychosis developed, he did not regard this development as in any way related to the treatment.

Dr. Richard Grace said that, with regard to preventive measures, the Medical Board for the examination of aviation candidates for the Royal Air Force might go further than they did in the psychological investigation of those applicants from

the public schools. A good opportunity existed for ascertaining the temperamental fitness of future pilots. The investigation did not go far enough, good though it was. A biological approach—taking into consideration the family history, personal history, and personality of the individual—was important. He remembered that while he was on the Medical Board there was a medical officer of a public school who took a great interest in the examination carried out and appreciated the importance of the temperamental fitness of youths for aviation duties.

A report from the school medical officer or headmaster might be most useful to the Board when a candidate came up. He (Dr. Grace) was treating at the moment an ex-officer of the R.A.F. who, no doubt, had responded well to the physical tests carried out on first entry, but who was discharged as temperamentally unfit after a year's service and whose record revealed on closer psychological investigation that he was possessed of the typical hysterical character. A report from his school on his previous personality would have precluded his entry into the Service.

Air-Commodore W. Tyrrell: As a Regimental Medical Officer who had first-hand experience under active service conditions of the factors and environment which predispose to functional nervous breakdown, I agree that the man without fear does not exist. Some men control and conceal fear better than others. The success or otherwise of the effort to control fear depends largely upon the individual's store of nervous energy, combined with a certain spiritual element (not necessarily religious). A prodigal expenditure of this energy is called for by the inherent desire and effort required to camouflage the exhibition of fear before one's comrades. The most effective factor in the conservation of this energy is the spiritual strength referred to above combined with the sense of sympathetic support and example from comrades subject to the same strain.

Here one must emphasize the importance of the proximity and influence of a trained, tried, and reliable medical officer, who not only shares the dangers, but also inspires confidence by his sympathetic interpretation and effective correction of the earliest signs and symptoms of decreasing nervous control. The ideal unit medical officer should be a practical psychologist with a wide experience of men, trained to observe—without appearing to spy upon—individual and mass reactions to the normal, as well as to the abnormal, situations, in order that he may be able, at the most effective moment, to advise correctly the temporary withdrawal of a man or men from immediate danger, with a view to reducing to a minimum the period of non-effectiveness.

With regard to the sources of functional breakdown, the following observations are submitted :—

The building up, conservation, and control of nervous energy, and vice versa, are largely determined by endocrine activities. The manifestations of fear ebb and flow directly with the multiple and subtle variations in the biochemical metabolism of the body, and especially in the endocrine secretions. The variations in endocrine activities are so subtle and multiple that in the anticipated and actual presence of danger, individuals and groups of men have been seen to demonstate, within a relatively brief period of time, the whole gamut of response to emotional stress, from sublime courage to craven fear. In other words, men are the creatures of their glandular secretion and in their physical bodies, stirred by spiritual stimuli, they are akin to chemical retorts.

The coincidence of danger with the maximum compatible mixture of endocrine secretions is most favourable for those demonstrations of individual courage that earn the title of "a man without fear,"—which would be better expressed as "a man who does not show fear," i.e. one who camouflages fear successfully.

Such super-men are by no means confined to the category known as "perfect specimens of physical manhood." There is a spiritual element, not, as I have said, necessarily religious, but usually associated with early training, environment, traditions, etc., which not only contributes largely to attainment and maintenance of control by the athletic type, but also assists the asthenic type to overcome his relative physical weakness.

It may be assumed that in the case of "the physical weed" who demonstrates consistent high courage the spiritual element predominates over physical handicaps.

In the ultimate "acid test," calling for sustained courage that endures and survives prolonged exposure to danger, the spiritual element—in the individual or the mass—is the decisive factor; hence the correct psychological, if empiric, reasoning behind the cultivation of patriotism, unit tradition, team-spirit, etc.

When the biochemists discover the secret of maintaining endocrine secretions at their optimum functional compatibility then only will the control of fear and the prevention and cure of functional nervous disease be placed on a proper basis. This presents a vast field for research. It contains the keystone of the problem and indicates the line of progress in preventive and therapeutic neurology.

Clinical and other Notes.

A CASE OF MALIGNANT ENDOCARDITIS OF THE PULMONARY VALVE DUE TO THE *STAPHYLOCOCCUS AUREUS*.

By Captain C. A. DE CANDOLE,
Royal Army Medical Corps.

THE patient, a British soldier, aged 25, was admitted to hospital on February 28, 1936, with a history of two days' frontal headache, pains in the back, shivering and general malaise. He died sixteen days later.

His temperature in the early stages showed a tendency to remissions, but later it became continuous. Physical signs were inconclusive at first; he had a large soft spleen and definite pulmonary signs. Later he developed a harsh, localized "to-and-fro" murmur at the base of the heart, and signs of deficient air entry at the base of the right lung.

He had some cough and sputum, and during the last few days coughed up varying amounts of dark airless blood. He developed a deepening jaundice in the last week, Van den Bergh's reaction being positive direct, and there was bile pigment in the urine.

The blood showed a rising leucocyte count until four days before death, when it fell to 7,000.

Staphylococcus aureus was isolated repeatedly by blood-culture; at first this was believed to be a contamination.

Post-mortem Findings.

Heart: Endocarditis confined to the pulmonary valve, with luxuriant vegetations and destruction and perforation of two of the cusps. The *Staphylococcus aureus* was isolated in pure culture from the left ventricle. Other chambers of the heart were normal.

Lungs: The pleural cavities were filled with bile-stained fluid. The right lung was extensively bound down by adhesions of recent origin, extending round to the back and up to the apex. There were a dozen or more large hæmorrhagic infarcts at the base. The left lung was relatively normal; there was a localized area of pleurisy with adhesions anteriorly near the base.

Spleen: Much enlarged—weight 34 ounces, engorged with dark blood and soft and diffluent, almost crumbling in the hands. The tissues generally were stained with bile but there was nothing else of note. No primary focus of infection was discovered.

Commentary.

Endocarditis involving the pulmonary valve is of rare occurrence, and end ocarditis confined to the pulmonary valve is particularly so.

The fulminating course and the luxuriant vegetations found post mortem are characteristic of infection by the *Staphylococcus aureus*, but the anatomical distribution of the lesions and absence of systemic infarcts made the diagnosis difficult.

[I am indebted to Lieutenant-Colonel A. G. Wells, D.S.O., R.A.M.C., Officer Commanding British Military Hospital (with Indian Wing), Mingaladon, for permission to submit this note for publication, and to Major F. A. R. Hacker, R.A.M.C., under whose care the case was, for the use of his clinical notes.]

CYANIDE FUMIGATION IN THE TROPICS.

By ERIC C. GILLES, L.R.C.P. & S., D.P.H., D.Sc.,
Port Health Officer, Colombo, Ceylon.

Part I.—Destruction of Bed-Bugs and Other Vermin in Barrack Rooms and Other Buildings!

Perusal of the literature reveals many methods recommended by different authorities for ridding buildings of bedbugs, roaches and other vermin, but most of them are successful only to a limited degree, as they lack power of penetration and often cause damage to material and fabrics; others again utterly fail in their purpose. The majority of methods used are in general only palliative, and of the numerous spray products, both liquid and powder, I doubt if any of them is successful in destroying the eggs, which require repeated treatment as new bugs hatch out. Formaldehyde gas has been recommended but has not met with universal acceptance, while the blow lamp used to disinfest the joints of metal structures, and the pouring of boiling water on wooden articles is only a waste of time and personal effort.

In the tropics where insect life is so prolific and buildings offer harbourage for bed-bugs in wooden floors, skirting boards, window frames, in cracks of walls and ceilings, complete eradication becomes a big problem, because many of the methods employed for their destruction do not kill the eggs or penetrate the cracks and crevices in which they conceal themselves beyond easy reach.

In Colombo cyanide fumigation introduced for the fumigation of ships proved exceedingly successful not only for the destruction of rats but for other forms of insect life in all stages of development found aboard vessels. Accordingly, it occurred to the writer to try out cyanide fumigation for the destruction of vermin in barrack rooms which in Ceylon are very heavily infested with bugs despite routine measures for their elimination with sprays, formaldehyde gas, blow lamps, etc. An experimental test was made on a section of the Echelon Barracks, Colombo, consisting of a two-storied concrete building with a tiled roof; it had a ceiling and a flooring of the

upper storey composed of boards; ventilation was by means of twenty-two glass windows and twelve doors of the venetian-shutter type.

The occupants of these barracks had all been provided with mosquito bell nets on circular cane frames suspended by a cord from the ceiling. This section was rather heavily infested with bugs and several complaints had been made by the men. The bed-bugs had not only infested the bed-clothes and bedding but by creeping up the mosquito curtains and the suspension cord to the ceiling, found the separations in the wooden boards there ideal for nesting and breeding; in fact the crevices in the wooden floors and separations between the window frames and the concrete masonry were all infested.

An opportunity was afforded to try out liquid HCN in this one unit, which consisted of 42,827 cubic feet of space to be fumigated. The entire block was evacuated by the men who left behind all their belongings. They sealed up efficiently the doors and windows of the building, making it more or less air-tight by pasting up all cracks and crevices with paper. This work of sealing was completed by noon, and fumigation commenced at about 2 o'clock in the afternoon. The belongings of the men left behind in the room were opened up; blankets, bedding, sheets, etc., were spread out on temporary lines drawn across the room, and after everyone had left the quarters, liquid HCN was introduced through one of the doors left slightly ajar, and afterwards sealed up. The dosage used was four ounces per one thousand cubic feet of space. The whole process of introducing the gas was over in about twenty minutes. Entrance to the building was blocked and posters placed to allow of no admittance, and thus it remained closed till the following day, the men sleeping that night in other quarters. Next morning at 9 a.m. the building was opened up and tests for the presence of HCN made by using methyl orange test paper. No trace of gas was detectable, so it was considered safe to enter. Though these barracks were exposed to the gas overnight, subsequent experiments have proved conclusively that the same dosage with only a four-hour exposure is sufficient to destroy all stages of insect life. None of the material exposed to the gas was in any way affected. The floor was littered with a fair number of dead roaches, lizards, spiders, and other insects.

More than a year has elapsed since the fumigation was carried out, and so far as it has been possible to ascertain no bugs have since reappeared. This is a clear indication that the dosage used was quite sufficient to kill both the bugs and their eggs, and the method is recommended as most effective in completely ridding barracks infested with bugs in the tropics. The old methods of spraying, flaming, etc., must give way to the greater efficiency of HCN, which is undeniably superior in every respect. The cost is not exorbitant, and though the gas is a deadly poison, with intelligent care by a responsible operator the risks are slight. There is no special difficulty about its use in the tropics, and one thoroughly

experienced worker with two reliable assistants can easily carry out successful fumigation with HCN.

PART II.—DESTRUCTION OF BATS WITH CYANIDE.

It may also be of interest to add here the results of another experiment with cyanide gas which gave equally satisfying results. As mentioned before, insect and rodent life in the tropics is so prolific that any building left unoccupied for even a short time is a silent invitation to vermin of all kinds to make it their new home, and so efficient and rapid is their means of communication that in a very short time the abandoned building is heavily invaded by these tenants. In addition, Ceylon has the problem of dealing with bats. Multitudes of them take possession of ruins, caves and deserted buildings. It can therefore be imagined in what condition a building, especially in the nature of a subterranean chamber, would be after a period of thirty years' disuse.

Such a building was called into service recently at Trincomalee, and when entry was attempted, apart from the musty noxious odour present, the persons who made the attempt found themselves pelted and battered as by a fusillade of machine-gun fire! An inconceivable population of bats was in occupation of the quarters, no doubt for the full period of inoccupancy, since guano covered the floor to a depth of thirty-two inches! The engineers detailed for work on this building could do nothing until this bat army had been exterminated, and they were at a loss how to proceed. At length they approached the Senior Medical Officer of the Ceylon Command.

In view of the fact that liquid hydrocyanic acid gas had proved so effective a short time previously in ridding barrack quarters of bugs, it was decided to gas the chamber to destroy the bats.

The building was kept open so that the bats, who are nocturnal in their habits, might return at dawn to their hiding place. At about 7 a.m. all entrances were hermetically sealed and the bat occupants of this long-abandoned building were unaware that a rapid and painless extermination awaited them. Advantage was taken of the ventilators on the roof through which, as well as an opening in the only door of the building gas was introduced, and the openings were immediately covered with jutesan and weighted down. Four ounces of gas per thousand cubic feet of space was the dosage, and as the rough estimate of space was 20,000 cubic feet, five pounds of liquid HCN was utilized. The gas was introduced at about 10 a.m. and retained until 2.30 p.m., when the roof ventilators and main door were opened and thorough airing permitted. Safe entry was possible about 5.30 p.m. the same day. It is indeed difficult to describe the sight which met the eyes of the spectators. On the deep layer of guano a blanket of dead bats lay as they had fallen; along the sides of the walls and dangling from the ceiling and roof, so closely packed as to form a dense cover, they hung as death overtook them.

The fumigation was entirely successful and the engineers were pleased

to be able to proceed with their duties, after clearing out the dead bat colony and guano. It was estimated that about forty to fifty thousand bats were thus destroyed.

These results are recorded in the hope that they may be of value to others faced with similar problems in other parts of the tropics. As an efficient, rapid and painless method of dealing not only with vermin but all forms of life, this experiment was good proof, for not only were the bats destroyed but also the parasitic forms of insects which thrive on them.

Numerous objections have been raised against the routine use of cyanide products, especially liquid HCN, as a means of eradicating vermin from buildings in the tropics. To my mind, these objections are over-stressed, due, I think, to lack of experience and want of application to preliminary details preparatory to the fumigation. It is true that liquid HCN like all cyanide products is highly toxic, but this makes it all the more valuable for the purpose. Long experience with liquid HCN leads me to consider it the most effective and penetrating fumigating agent I have used; it has the advantage of speedy application, cleanliness, with no damaging effects on furnishings or merchandise, of leaving no odours or having deleterious after-effects, and most important of all, it can be applied from outside the building or quarters to be fumigated so that the risk to the operator is greatly diminished. Only those who have carried out successful cyanide fumigation can thoroughly appreciate the results obtained.

To those contemplating a fumigation, doubtless the question of cost is of foremost consideration. The actual cost of the HCN gas used in the two experiments cited was as follows:—

	Capacity cubic feet	Cost of gas
Barrack room	43,000	£3 12s. 8d.
Bats at Trincomalee ..	20,000	£1 13s. 8d.

In the event of the Army employing this method of disinfestation, there would be a reduction of 25 per cent on the above cost. The only extra items to consider are the applicator, hose, spray, connexions, etc., all of which may be procured for about £5, becoming permanent equipment. Gas masks, of course, are necessary, and the ordinary Army service gas mask equipped with suitable filter canister will give the necessary protection. There appears to be a general impression in the Army that fumigation with HCN is best handed over to some firm of professional fumigators. This is hardly necessary, for there is no reason why men of intelligence with a due sense of responsibility cannot be chosen from the personnel of the R.A.M.C. to be trained for this work, thereby causing considerable saving in public funds.

Both of the experiments cited were carried out through the courtesy of Colonel R. M. Dickson, M.D., O.B.E., S.M.O., Ceylon Command, and with the consent of Dr. R. Briercliffe, C.M.G., O.B.E., Director of Medical and Sanitary Services, to both of whom I am extremely grateful for affording me these opportunities of using liquid hydrocyanic acid for the first time

in the Far East. I also wish to thank Messrs. Shaw, Wallace and Company for making available the liquid HCN for these experimental purposes, as well as for all the necessary equipment supplied.

Echoes of the Past.

WAR EXPERIENCES OF A TERRITORIAL MEDICAL OFFICER.

By Major-General Sir RICHARD LUCE, K.C.M.G., C.B., M.B., F.R.C.S.

(*Continued from p.* 66.)

Chapter X.—The Western Frontier.

On reaching Alexandria the Headquarters of the 2nd Mounted Division proceeded at once to Cairo. The remnants of the original brigades of the 2nd Mounted Division were already assembled in the camp close to the Pyramids at Mena, which had been occupied the winter before by the Australian Divisions, and were busy re-organizing. They had picked up their horses and were collecting new equipment and reinforcements. The Divisional Headquarters moved out to Mena on December 29, and established itself in the Annexe of the Mena House Hotel.

The two field ambulances which we had taken to Suvla, the 2nd South Midland and the London, were already at Mena. The other two, which had been left behind, were with the Western Frontier Force, now operating against the Senussi on the coast to the west of Alexandria. The Scottish Horse and Highland Mounted Brigades had not yet arrived from the Dardanelles.

It was arranged that as soon as their equipment was complete the brigades were to move down in succession to Salhia, a desert camp not far from the north end of the Suez Canal. The 1st South Midland Brigade was ready first and moved off to Salhia on January 3, taking with them one section of the 2nd South Midland Field Ambulance.

Of the Notts and Derby Mounted Brigade the Derbyshire Yeomanry had gone to Salonica some time before and taken with them part of the 1st South Midland Field Ambulance, and it was now decided that the remainder of this brigade should follow them. They left about January 14, and took with them a section of the London Mounted Brigade Field Ambulance which, with the section already there, would make up a complete field ambulance for the brigade. The re-organization of the other two brigades took some little time and before it was completed an alteration of plan was made which resulted in the Division being broken up.

The position of affairs in Egypt at the beginning of 1916 was as follows :—

The evacuation of Gallipoli having set free the Turkish army there, it was fully expected that it would be utilized for a renewal of the offensive against Egypt. The main part of our own troops who had been withdrawn from the Peninsula was being concentrated for the defence of the Suez Canal. Moreover, during our absence trouble had arisen on the Western Frontier of Egypt.

Out in the Libyan desert not far from the Tripoli border of Egypt, nearly four hundred miles from the Nile, and about two hundred miles from the Mediterranean coast, lie the two oases of Siwa and Jerabub. They are nominally under the rule of Egypt.

In ancient times Siwa was the site of the famous Temple of Jupiter Ammon, whose oracle had a world-wide reputation, second only to that of the Temple of Apollo at Delphi.

Jerabub, fifty miles to the west of Siwa, had during the latter half of the nineteenth century become the headquarters of a new sect of Mohammedans. The real founder of the sect was an Arab shiekh named Mohammed Senussi, though the tenets of the sect had been worked out some thirty years earlier. He set himself up as a prophet, and introducing certain changes in minor points of doctrine founded this new sect, his followers taking the name of Senussi after him. The original scenes of his proselytizing work had been the hinterland of Tripoli and the oases of the Libyan desert, but his influence had gradually spread as far as the western borders of Egypt itself, and in the province of Fayum especially the sect had gained large numbers of adherents.

Mohammed Senussi had always been a firm friend of the British Government, and in spite of earnest solicitations from the Mahdi to join him against us in 1884, he refused to do so, and maintained his friendly relation with England as long as he lived. He died in 1902, and was succeeded by his nephew Mohammed Sayed Ahmet, who adopted the title of "the Grand Senussi."

Mohammed Sayed Ahmet, though a man of little personal courage, had considerable ambition and possessed large ideas of his own importance. During the early months of the War, though bitterly opposed to the Italians, he had posed as a friend of England, but under the influence of Turkish agents, of whom Nuri Bey, a half brother of Enver Pasha, was the chief, and no doubt also encouraged by liberal distribution of German gold, he went over to the side of Turkey. For some time he acted with considerable duplicity, no doubt with the object of improving his bargain with his new friends. He did not declare himself until a rising on the West Coast was thoroughly organized. With the assistance of Turkish officers he had collected a more or less drilled and disciplined army, which was put into some sort of uniform, equipped with modern rifles and a few mountain field guns. How this equipment was brought into the country

it is difficult to understand, it must have been conveyed chiefly in submarines and landed either on the Tripoli coast or at out-of-the-way spots between Alexandria and the frontier.

Egypt, west of the Delta and the Nile Valley, though covering a considerable area on the map, is of little importance politically. Along the Mediterranean coast between Alexandria and the frontier port of Sollum, there is a strip of more or less cultivated land varying from one to ten miles in width. Parts of this are fertile and raise some of the best malting barley in the world. The rest is covered with a rough scrub only fit for grazing, where large numbers of camels are bred and reared. There is a fair rainfall in the winter months which is confined to the immediate neighbourhood of the coast. The whole of the rest of Western Egypt is a vast desert dotted with a few oases.

With the exception of the two already referred to, Siwa and Jerabub, these oases form a chain running north and south more or less parallel with the Nile and at a distance varying from fifty to a hundred miles from it. The names of the principal ones starting from the coast are Moghara, Wadi Natrun, Fayum, Baharia, Farafra, Dakhla and Kharga. The Fayum is densely populated and forms a definite province of Egypt. The others are much isolated from both Egypt and one another, and with difficulty support a small population, of a very low type, by agriculture. The most lucrative crop is dates, which are exported to Egypt.

The Fayum, the largest of the oases, differs from the others in that it is nearer to the Nile Valley and directly connected with it by a narrow strip of cultivated ground. Moreover, it owes its fertility, not to springs like the rest of the oases, but to an efferent branch of the Nile known as the Bahr Jussef. This branch leaves the Nile at Deirut, nearly four hundred miles above Cairo and running down the western edge of the valley parallel with the main stream turns westwards into the desert at a point about forty miles from Cairo. After proceeding some fifteen miles westward, it passes through a narrow gap in the hills and soon after begins to break up into a very complete system of irrigation canals spreading water over the whole 500 square miles of land which forms the Fayum Oasis. The unused surplus water is collected again by a system of drains and makes its way into a small inland lake, known as the Qarun Lake, a miniature Dead Sea which lies 130 feet below sea-level. The province is one of the most fertile parts of Egypt, and besides supporting a very large population, sends much produce to the Cairo markets.

The water of the Bahr Jussef, like the Nile itself, is charged in flood time with that wonderful fertilizing mud which comes down by the Blue Nile from the highlands of Abyssinia and, remaining in suspension till the last minute, is spread in a fine layer over the whole surface of irrigated Egypt. This acts as an artificial manure and has enabled the soil to produce without flagging three magnificent crops a year for the last 4,000 years.

The geographical history of the Fayum is interesting owing to its connexion with the Lake of Moeris referred to by Herodotus, who describes it as 350 miles in circumference and 350 feet deep. The present lake is about six miles long and less than a mile across. Probably, therefore, in his day almost the whole of the existing Fayum was one big lake. He also speaks of the lake as a reservoir used for the irrigation of the Delta. Apparently the water of the Bahr Jussef filled up the lake during the High Nile season and then during the Low Nile it was allowed to flow back into the Nile Valley to be used for irrigation purposes. The present level of the Fayum lake is 130 feet below that of the Bahr Jussef where it enters the Fayum, so that the lake must have been 130 feet deeper in those days than at present.

Much has been written on this interesting subject and different theories have been expounded even as to the position of the Lake of Moeris itself, but this seems the simplest explanation. At some unrecorded point of time, whether because the water of the Bahr Jussef ceased to fill the lake to the required level or because it was found more profitable to reclaim the bed of the lake and use the water of the river to irrigate the newly-drained land, Lake Moeris ceased to be used as a reservoir and the lake began to shrink until it reached its present modest dimensions.

The origin of the other oases is different. They depend for their water supply on natural springs. They are all situated in depressions in the surface of the desert and it seems as if there is a subterranean stream making its way northward parallel with the Nile, which crops up to the surface in these depressions. In some cases, as for instance in Dakhla, when an opening is made through the surface the water rises under pressure as much as a foot from the ground. This subterranean river must come, like the Nile itself, from Central Africa, as there is no rainfall nearer from which its water can be derived. Unfortunately, unlike the Nile, the subterranean water does not bring with it the fertilizing mud which is the feature of the Nile itself. These oases are not, therefore, fertile in the way that the Nile Valley, the Fayum and the Delta are.

The first object of the Grand Senussi and his advisers was to gain possession of the coastal villages which previously had markets for a certain amount of trade with the Bedouin and which had been garrisoned by detachments of the Egyptian Coast Guards. The most important of these villages are Daba, to which a line ran out from Alexandria; Mersa Matruh, a land-locked harbour about one hundred miles west of Alexandria, suitable for small vessels; Barrani, fifty miles further west; and Sollum, on the Tripoli border. A track called the Khedival Road runs along the coast from Alexandria which is usable in fine weather by motor cars, but impassable after heavy rain. The road to Siwa leaves the coast at Mersa Matruh.

The Senussi began operations by forming a camp on the edge of the cultivated area a few miles south of Sollum. Two small ships, a coasting

vessel and an Egyptian gunboat, were sunk in Sollum harbour by a German submarine, and the crews were carried off as prisoners inland.

The garrison of Sollum was withdrawn by sea and at the same time that of Barrani by land to Matruh. A good many of the Egyptian Coast Guards, including a clever N.C.O. named Saleh, deserted to the Senussi. This man played an important part subsequently in the Senussi operations.

Troops were at once sent out from Egypt to occupy Matruh. By the end of November 1915, a fair-sized force had arrived under the command of General Wallace and had constructed an entrenched barbed wire camp. In the meantime, the Senussi, about five thousand strong, had moved eastwards and were threatening Matruh; about one thousand of their troops were so-called regulars and the remainder partially armed Bedouins. A skirmish occurred on December 11 between a yeomanry patrol and the enemy. On Christmas Day General Wallace moved his force out to attack the Senussi camp situated on a hill a few miles south of Matruh. It afterwards

1st Australian Light Horse Camp, near the Nile.

transpired that the enemy had been preparing to attack our camp on the evening of the same day, hoping to find the Christians overcome with the festivities of the great day. The action, though successful to our army, was not decisive, as the state of the country after heavy rain made it necessary for the troops to return to their camp at Matruh. Some weeks of inaction followed, during which the alarm spread into the oasis of Wadi Natrun and to the Fayum. The numerous adherents of the Senussi sect in the latter province were very disaffected. Anything like a reverse to the British force on the coast would have brought about a rising against us there.

Sir John Maxwell, who commanded the forces in Egypt, and who was responsible for the defences of the Western Frontier, hurried troops down

to the Fayum, to Wadi Natrun, and to the towns along the Nile as far south as Minia. He also decided to create a special force for the defence of this area, which he called the Southern Force. The command of it was given to General Peyton, just released by the breaking up of the 2nd Mounted Division. General Peyton took with him most of his old staff, and I was appointed Assistant Director of Medical Services (A.D.M.S.). The Headquarters of the Force were established in the old army headquarters in Cairo, General Maxwell's headquarters having moved some time previously to the Savoy Hotel. The troops placed under General Peyton's command were the 53rd Territorial Division, which on its return from Gallipoli had been sent straight to Wardan on the western edge of the Delta; the North Midland Mounted Brigade of Yeomen and the 1st Australian Light Horse Brigade, remounted after their return from Anzac. To these were soon added the Highland Mounted Brigade (dismounted) and four battalions of 2nd Line London Territorials.

North Midland Mounted Brigade Field Ambulance, Fayum.

One brigade of the 53rd Division and the North Midland Mounted Brigade were posted at various points in the Fayum. The Light Horse was partly in the Wadi Natrun oasis and partly distributed along the western fringe of the Nile valley south of Fayum. The Highland Mounted Brigade was sent still further south to Minia. The London Territorials garrisoned the various towns along the Nile.

General Peyton made a complete reconnaissance of the Fayum between January 26 and 30. I accompanied him and in the four days we travelled by car over practically the whole of the province, visiting every garrison and every point of importance.

The *Mudir*, or Governor of the Province, who was an ex-Egyptian cavalry officer and a Bedouin by descent, gave us a most hospitable reception and a luncheon of twelve courses, while his English Political Adviser

made our trip a most interesting one by his excellent arrangements. The roads, though very rough for motor cars, were quite passable, and we were able to cover a large amount of ground in the few days. Owing to the irregularities of surface where the stream runs down towards the lake, the scenery is varied and quite unlike the dead monotony of the Delta and the Nile Valley. At the same time one is struck everywhere by the extraordinary luxuriance of growth and by the air of prosperity of the inhabitants. They are no better dressed or housed than elsewhere in Egypt, but the thronged village markets, the crowded trains of the light railway system which extends in all directions through the province, betoken the busy, successful life of the people. They gave no signs of active hostility as we passed, but their looks were far from friendly, and one could not help feeling that only a spark was required to turn them into fierce and fanatical enemies.

In the meantime, a more active policy was being inaugurated on the coast. On January 22 a mixed force left Matruh, bivouacked for the night at Birshola, and engaged the enemy force, numbering about three thousand, at Halasin, the next day. After holding their ground well all day the Senussi began to fall back westwards towards nightfall. Their camp was occupied and burned by our troops, but, owing to the bad weather and difficulties of supplies, the force had to return again to Matruh.

On February 9 General Peyton was transferred from the Southern Force and given command of the Western Force. He at once started an active offensive with a view to dealing the Senussi a crushing blow and regaining possession of the whole coast.

A column left Matruh on February 20. On the 25th they were within twenty miles of Barrani and found a force of the enemy at Agagia. With General Lukin in command, the column, consisting of the South African Brigade and Dorset Yeomanry, attacked the enemy's position, and after a stiff fight, in which the Dorset Yeomanry made a spirited and successful charge, the Senussi were put to flight. The Commandant, Gaafer Pasha, was captured with his staff. The column marched in pursuit towards Sollum and the enemy was met again about twenty miles west of Sollum, which is the frontier village. This was the day of the armoured cars. They charged in line into an enemy position, wiping out a mountain gun and two machine guns and putting the whole force to flight. Sollum was occupied without resistance. This practically finished this part of the campaign.

On the departure of General Peyton to the Western Force, General Adie was appointed to the command of the Southern Force. It soon became evident that Cairo was not the best place for our Headquarters and we moved on February 12 to Beni Suef, a town of some size on the west bank of the Nile, about eighty miles from Cairo.

The problem of the defence of the Western frontier of Egypt was a

difficult one, though not on account of the numbers and strength of the enemy, for it was impossible for them to muster more than a few thousand armed men against us, and their supply of munitions must always come to them from across a sea on which no hostile vessel dare show itself. The difficulty arose from the immense length of the line to be held, from the mobility of the enemy and from the fact that they were working on interior lines against our right angled frontier. It was impossible for us to send any force into the desert to attack them without making vast preparations for the supply of water and food and for the maintenance of lines of communication for the attacking force. Moreover, we had behind us in Egypt a hostile population who would welcome the advent of a raiding force and probably rise in revolt if it met with any sort of success. It was

Headquarters, Southern Force, Beni Suef.

necessary, therefore, to distribute our troops over the whole frontier, and in such strength at the vulnerable points that a raid could be met at any one point without having to concentrate from a distance.

This involved the employment of a large force to make the frontier safe from attacks of an enemy who could never number more than a few thousands. At one time the strength of the Western Frontier Force was nearly fifty thousand.

A definite move south was made by the Senussi shortly before their final defeat on the coast. Baharia was occupied by them in February and Dakhla on March 7. This move necessitated a corresponding one by the Southern Force. It became a race for the possession of the oasis of Kharga which lies between Dakhla and the Nile Valley, sixty miles from the former and one hundred from the latter. This oasis was already connected with the Nile Valley by a light railway which had been constructed some years

before by a company formed to develop the oasis commercially. The company had failed and the railway was sold to the State.

The Highland Mounted Brigade, relieved by the South Western Mounted Brigade, which had just joined the Force, was sent south to occupy Kharga.

The 1st Light Horse Brigade was also moved south and posted along the Nile Valley at points which might be threatened from Dakhla or from Kharga should it be occupied by the Senussi before we could get there. Some of the London Territorial troops were also sent down south to garrison Esna, a little town on the Nile between Luxor and Assouan, where there is an important barrage or dam of the Nile.

On March 20, the 4th Dismounted Brigade, consisting of the Welsh Border Brigade and the South Wales Mounted Brigade, recently out from England, were added to the Force and stationed at Wardan to replace the 53rd Division which was now moved in to the Fayum.

CHAPTER XI.—CLEARING THE OASES.

ON April 3 all fear of successful action by the Senussi on the coast having been removed by their severe defeat and by the occupation of Sollum, the old Western Force was broken up and its residue amalgamated with the Southern Force. Thus was formed the Western Frontier Force, the command of which was given to General Peyton, who made up his staff from both the old forces. I remained on as A.D.M.S. The Headquarters moved back from Beni Suef to Cairo. General Peyton himself went on leave to England and did not return, and the command devolved temporarily upon General Dallas who was commanding the 53rd Division.

The responsibilites taken over from the old Western Force included the garrisons of the coastal towns of Sollum, Matruh and Dabaa. The troops used to form these garrisons were the 2/7th Middlesex Regiment, 1/6th Royal Scots, at Sollum; 2/6th Middlesex at Matruh and the 1/2nd County of London Yeomanry (The Westminster Dragoons) and 2nd Garrison Battalion King's Liverpool Regiment at Dabaa. The only medical unit taken over was the 16th Stationary Hospital, which was divided between the three places.

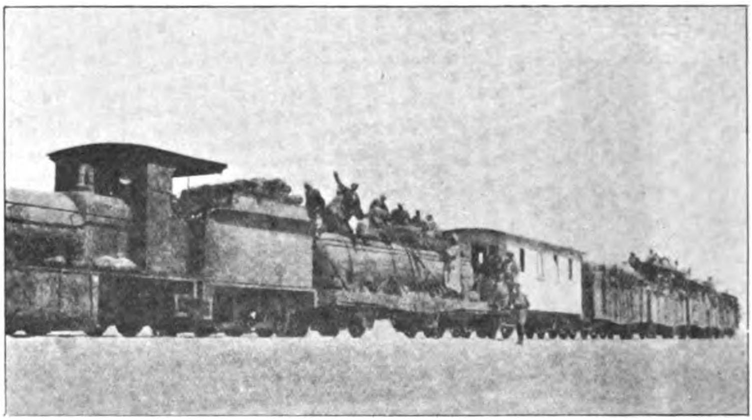
The Western Frontier Force administration was divided into two sections: a Northern, consisting of the coastal towns, Wadi Natrun and the Fayum, and the Nile Valley as far south as Minia—and a Southern section consisting of the Nile Valley south of Minia.

The Highland Mounted Brigade was moved up by rail to Kharga on April 18 and occupied the oasis without opposition. This oasis bore a very evil reputation on medical grounds. Some years ago the Egyptian Government, following a precedent dating from Roman times, decided to establish a convict station in the oasis and laid out a considerable sum on buildings for the purpose. It was found, however, that the prisoners were so terribly affected with malaria that the scheme had to be abandoned. The malaria was a bad type of the malignant form; it was not a very cheerful prospect

for us, therefore, to have to maintain a considerable force there during the coming malaria season. Very careful consideration was given to the selection of the best site for the garrison camp.

Malaria is fortunately a very local disease. The mosquito does not travel far from his breeding place and cannot breed without water. The camp site selected was Sherika near the middle of the north part of the oasis, the headquarters of the old company. Here there were some good permanent buildings in fair repair and there was no native village. A good water supply existed, but no irrigation was being carried on. The troops were encamped on desert sand, except those in the permanent buildings.

As it turned out the selection was a good one. Though some malaria cases occurred, the number was never serious and the health of the troops in Kharga, in spite of the fact that they lived there during the heat of the summer and through the malaria season of the autumn, was on the whole very good.



Hospital coach on desert rail to Kharga.

About the same time that Kharga was garrisoned, General Dallas decided to occupy the oasis of Moghara, the most northerly of the chain running parallel with the Nile. It lies thirty miles from the Mediterranean coast and about fifty-five miles west of Alexandria. It is uninhabited, though used by the Arabs on trek from Siwa to the Delta and might be used as a jumping-off point for a raid on the Delta. The occupation of this oasis was a most costly business. Every drop of water used by the garrison had to be carried out on camels as the water there is brackish and too salt for consumption by Europeans. The road was so bad and stony that a journey there by motor car was hardly ever accomplished without the destruction of at least one tyre. The oasis was occupied for nearly nine months, and though constant patrols were made from it no Arab convoy was ever intercepted by the garrison.

The camp was converted into a veritable fortress, all the materials for

which had to be carried out on the backs of camels. It was a desolate place and life there was insufferably dull. The only occupation was that of perfecting defences, and the only recreation that of hunting for the fossil bones of extinct animals which abounded in the neighbourhood.

As time went on it was realized that the Libyan desert is particularly suitable for the use of motor cars. Vast areas previously crossed only on rare occasions by adventurous Europeans on camels were now becoming criss-crossed in all directions with the wheel marks of Ford cars. With the exception of certain sand dunes impossible to negotiate—too steep to be rushed and too long to ride round—there was no part of the desert which was not ultimately found to be accessible by means of the motor car.

The combination of Camel Corps and the light Ford car patrols made it almost impossible for a Bedouin to stir in the desert within the area watched by them without being discovered. So good, too, was the going that it would have been possible for the armoured car batteries to have driven round and round any hostile body caught in the open and to have annihilated them without any appreciable risk to themselves. When this was realized the fear of an invasion or raid practically disappeared, but the Higher Command was taking no risks. The only way to ensure absolute safety was to attack the Senussi in their lairs in those far off, inhospitable oases which still remained to them and to drive them off the map of Egypt altogether.

Whether the very heavy expense that was incurred in carrying out this policy was worth while under the circumstances is a matter which might be debated, but it was the only thorough method and it was adopted.

The oases remaining to them were, in the North, Siwa and Jarabub, in the South, Baharia, Farafra and Dakhla. The last three were to be tackled first. Farafra was practically negligible. Its cultivation was too small to support any addition to its normal population, and it lay between the other two with no outlet save by them. It was decided to send simultaneous expeditions to Dakhla and Baharia. The one from Kharga, already in our possession, the other from the point in the Nile Valley nearest to Baharia.

The risks to an expedition marching out into the desert without proper base and water supply were well realized. Khamsin dust storms are a very real danger. They come on suddenly and often last several days, during which time it is impossible for men to move in the open and at the height of the storm there is nothing to be done but to cover one's head and face from the dust and turn one's back to the blast. There is a well-founded historical tradition that in the time of Cambyses, the Persian king who conquered Egypt, an expedition ten thousand strong started to march across the desert from Egypt to Siwa, and that they disappeared in a sand storm and were never heard of again. One can well believe that an army,

overtaken by such a storm, without water and without shelter, might easily be wiped out and leave their well-picked bones to whiten on the burning desert; now covered, now left bare again by the shifting sand as the ages rolled along. Such a risk could not be faced by a British army in order to overthrow a few thousand fanatic Bedouins whose power of offensive had already been reduced to a minimum.

The supply of water and provisions for the expeditions was the great problem.

Baharia was one hundred and twenty miles from the nearest water supply and Dakhla over sixty. Strenuous but ineffective efforts were made to discover water in the desert by boring with costly machinery. Professional water diviners were employed by the anxious authorities but without success.

The original scheme to rush an expedition to Baharia, similar to the attempt made by the Turks to reach the Canal in 1915, with camel transport, was abandoned at the last moment on the representation of the engineers that there was a serious miscalculation in the estimated water supply. The slow but more certain method of constructing a railway had to be resorted to, the method adopted with such great success by Lord Kitchener in his advance to Khartoum in 1897 and to be employed with equal success later in the year, in the advance of our army across the Sinai Desert to Palestine.

The Egyptian State Railway knew all about this method; the heads of the Department were British ex-R.E. officers who had served under Kitchener and were experts in the laying of desert railways. It was obvious, however, that this addition to the programme would add enormously to the expense of the expeditions and cause considerable delay in their accomplishment. Even the Egyptian State Railway, with all its experience and with the excellent labour of the Egyptian *Fellaheen* at its disposal, cannot advance a railway at a greater rate than a mile per day. To the work of laying the line to Baharia was added that of erecting a series of block house depots at marching distance intervals along the railway, each provided with a good sized masonry reservoir for water.

With the railway completed up to a point within thirty miles of the oasis, it was thought safe for the expedition to jump off from railhead, carrying its own supplies. Many months had elapsed before all arrangements were complete.

In the case of Dakhla it was only necessary to continue the existing railway to Kharga along the route between the two oases for a distance of about another twenty miles. A depôt and water store were established at railhead which received the etymologically curious name of Water Dump A.

It was the middle of October before the two expeditions were ready.

The great question was whether the Senussi would stay to receive us. By October 7 reports came in that they were leaving Dakhla. Two days later similar reports came from Baharia. Modifications were hurriedly

made in the plans in order to push on the expeditions, and, if possible, to catch the stragglers, smaller and more mobile forces being employed.

Dakhla was reached on October 16 and Baharia on October 17, without fighting but too late to capture more than a remnant, most of whom were medically unfit to undertake the arduous journey across the desert to Siwa. An attempt was made to cut off the retreating Arabs by a motor machine gun column sent round the north end of Baharia, but it missed them. The inhabitants of the oases received us with open arms. They had grown tired of their visitors, who in the long months of their occupation had eaten them out of house and home and left them almost starving.

Sayed Mohamed and the remnant of the Senussi made their way back to the Siwa which, except Jerabub, was the only habitable spot left to them on Egyptian soil. It only remained, therefore, to turn them out of this

The landing-stage, Mersa Matruh.

last resting place. Making a railway to Siwa was not to be thought of, so it was decided to deliver the *coup de grace* by means of a motor column, This was fitted out at Matruh under command of Brigadier General Hodgson of the S.E. Mounted Brigade and consisted of Rolls Royce armoured cars. eight Ford patrol cars, about twenty motor lorries and four motor ambulances. The Expedition left Matruh on January 30, 1917.

The remnant of the Senussi army under the deserter Coast Guardsman Mohammed Saleh, who had been the leading spirit in the Southern movement, was known to be encamped in the oasis a few miles to the west of the town of Siwa. The plan of operations was to attack the camp with the main force of cars, sending a detached force to watch a pass some fifteen miles to the west on the road between Siwa and Jarabub, with the intention of cutting off their retreat. The main road into the bed of the oasis was known to be mined, but a new track down the almost precipitous sides was discovered. The Senussi camp was found and attacked at once. A stubborn resistance was offered, for the enemy still possessed two

mountain guns which they used with considerable effect, though fortunately no direct hits were secured on any of the cars. Our machine guns at short range caused considerable losses to the enemy and cut short their one attempt at an offensive. Night came on without a decisive result, but during the night the Senussi trekked off westward, blowing up their ammunition stores before they left.

The detachment of cars that had gone westwards reached the appointed place after considerable difficulties and was in time to ambush the head of the column of Senussi moving westwards the morning after the fight, but the enemy advance guard gave the signal to the remainder to change the route and the nature of the ground prevented further pursuit. Siwa was entered next day and a few captures made, but the prisoners could not be brought away owing to lack of room for passengers in the cars. This most successful expedition ended the Senussi Campaign. No further attempt was made to dispute our control of any part of Egypt.

The Grand Senussi, who had been at Siwa, left for the interior before the battle; Mohamed Saleh, the Coast Guardsman, mounted on a white horse, was recognized directing operations with the Senussi in the fight by one of the British Coast Guard officers who was present with the Expedition. He, too, made his escape with the main body.

Some six months later, in the summer of 1917, the perfidious and elusive Sayed was reported to be on his way in a German submarine from the Tripoli coast to Constantinople. It was obvious after this complete round up of the Senussi and the capture of their last stronghold in Egyptian territory that the functions of the Western Force had practically come to an end, and that most of us must expect to be transferred to other work.

(*To be continued.*)

Current Literature.

KOLMER, J. A. Une méthode efficace de vaccination contre la poliomyélite antérieure aiguë. [**An Effectual Method of Vaccination against Poliomyelitis.**] *Ann. Inst. Pasteur.* 1935, v. 55, 365-79.

Although this article is written in French the author is an American who is professor of medicine at Temple University, Philadelphia, U.S.A. As the article deals with a vaccine obtained from spinal cords of monkeys, it is indeed fitting that it should appear in a publication issued by the Pasteur Institute. The author has succeeded in preparing a vaccine which he has used with success for immunizing against poliomyelitis. The vaccine is obtained from the spinal cords of monkeys who have been infected with the virus of poliomyelitis. The spinal cord is used in preference to the brain as it contains more virus; one spinal cord will give

about 150 cubic centimetres of vaccine, which is sufficient to immunize 40 to 50 children according to age. The vaccine is regarded as entirely without danger for the immunization of man, not only because it is prepared with a virus after several passages, but also on account of its attenuation by being dissolved in a 1 per cent solution of sodium ricinoleate.

Twenty-five children and two adults received injections and the quantity of antibody was estimated in each case before and after. Fifteen of the children were found by neutralization tests to have no viral antibody before the injection, and in 11 of them large quantities were found in the blood a week after the last injection. Ten were found to have some antibody in the blood before injection and in all of them it was markedly increased after the injections. In each of the two adults injected a large quantity of antibody developed without any injurious reaction. Hence 23 out of 27 injected produced large quantities of antibody. In none of them was there any general reaction and any slight local reaction at the site of the injection disappeared in forty-eight hours. A negative phase did not seem to occur. The quantity of antibody produced by the injections is comparable to that which is found in the blood after natural immunization and is believed to be sufficient to protect against poliomyelitis. Two monkeys have remained immune to poliomyelitis for two years after injection.

The author considers the vaccine is now suitable for general use in epidemics, especially on children. A. J. Collis.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 1.

Ivory, G. H. **Raw Water Supplies with Special Reference to Nigeria.** *Surveyor*, 1934, v. 86, 563. [Summary taken from *Dept. Scient. and Indust. Res. Water Pollution Research. Summary of Current Literature*, 1935, v. 8, 79.]

Abstract of a paper communicated to the Institution of Civil Engineers. Gives data on the geography, rainfall and water supplies of Nigeria. The country may be divided into four zones : a coastal belt of swamp and dense forest, forest land north of the coastal belt, hilly and comparatively open country to the east, and a high undulating thinly forested plateau in the north. During the dry season, which lasts about six months and begins in October in the north, the maximum daily variations in temperature and humidity occur. Mean annual rainfall for the four zones in the order given above is 192·45, 91·37, 56·44 and 43·00 inches respectively. In dry years, annual rainfall may be less than one-half of the mean. Rainfall has been decreasing during the past forty years. Chemical analyses of raw waters from fifteen stations showed that the maximum values for nitrogen, oxygen absorption, total solids and pH are generally during the rainy season and occur later in deep-lying springs than at other sources. Lake waters showed little seasonal variation. Most of the waters were soft and acid and contained no nitrite nitrogen. Sources

of water in Nigeria should be tested throughout the seasons before designing works for their utilization. Adjacent sources of water may differ considerably in quality. Acidity is usually greatest in spring water; in river water pH increases with the size of the river. In some cases acidity is due to carbon dioxide and may be economically reduced by aeration, e.g. at Akure, where the pH of spring water is raised from 5·9 to 7·0 by allowing it to fall five feet through four horizontal iron troughs and a bed of broken limestone. At Lagos water is treated by aeration, aluminoferric, soda ash, filtration and chlorination. Tests on the aeration of water by compressed air, passage over weirs and spraying, showed that pH was usually raised from 5·6 to 6·8 when a head of ten feet was used. The increase in pH was fairly constant for each foot of head.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 2.

Comfort Cooling by Solar Radiation: Novel Method of Air Conditioning. *Cold Storage,* vol. 39, p. 35. February 20, 1936.

The possibility of harnessing the sun's rays for air conditioning has been the subject of study and experiment which has led to the invention of Dr. Ing. e.h.E. Altenkirch, of Berlin. The illustration shows the layout diagrammatically and it appears that ventilation shafts are constructed in hollow walls on opposite sides of a building, the east and west walls being selected on account of the former being exposed to the sun's rays in the morning and in shade after noon, and vice versa.

Briefly stated, the apparatus is an intermittent operating adsorption or dry absorption refrigerator having two working periods per day, with atmospheric air as the working fluid; an absorber-generator is fitted to the outside of the two walls in communication with the ventilating shafts. In the morning the east wall is the generator and the west wall the absorber; air is dried on entering through the west wall and is cooled as desired in the moist wick apparatus at the point of entry into the building. At noon (by solar, and not "summer" time) both apparatus are neutral except for the residual heat which continues to operate the east wall for a short time; then the latter becomes the cooler wall, and the west the hotter; the position is now reversed. No condenser or evaporator is required, as air passes through in a continuous stream and is not recirculated.

The method has great attractions, as in sunny weather conditioned air at comfortable temperature and humidity can be obtained without the expenditure of any power, fuel or electricity, and only a microscopic quantity of water is required for adjusting the humidity. As solar radiation is the main cause of uncomfortable heat, the majority of summer conditions can be catered for without running costs. Only in humid, cloudy days would it be necessary to activate the apparatus by artificial heat, and heaters for this emergency purpose are incorporated in the design.

It will be seen that the employment of this economical method of

cooling calls for special consideration, not only in design of buildings, but also in their orientation when the site is being planned. The former is a very simple matter to arrange provided it is considered at the right time. The latter shows that the direction of roads in housing estates has an important effect on the practicability of nature-assisted refrigeration. It is a common practice in India to plan towns so that the majority of the houses can have a north verandah in order to obtain shelter from the sun as much as possible, and at the same time to take full advantage of the prevailing wind ; two sides of houses are placed squarely east and west. In this way the total heat absorbed by a building is reduced to a minimum, especially if the roof is of a plain pent type with the gables facing north and south. In European latitudes, with a greater inclination of the sun from the perpendicular, the form of roof has much less effect on heat absorbing capacities.

DUDLEY, S. F. **The Biological Approach to the Study of Epidemiology.** *Journal of the Royal Naval Medical Service.* Vol. 22, No. 2, April, 1936.

" Epidemics being the visible reaction of herds to certain types of parasites are essentially biological phenomena." On this text Admiral Dudley has built up an extremely interesting and philosophical paper, the interest of which is added to by the fact that many of the observations used to illustrate his arguments are from his own work.

He begins by contrasting the value to be obtained from experimental studies in epidemiology on the lines developed by Topley and Greenwood with the older method of observation and comparison of events as they occur in Nature, finding the two methods of approach to be complementary but insisting that the comparative method is necessary to control the generalizations so readily made from isolated experiments and to keep experimental results in a definite relation to the total problem.

Passing on to consider natural selection he points out that any hypothesis pretending to describe the origin and behaviour of epidemics must be in agreement with the accepted principles of evolution by selection. On this basis he considers that the variable degrees of natural immunity to disease among races and individuals are due to genetic inheritance, and that acquired immunity, being a purely acquired character, can never be inherited although the power of acquiring immunity from appropriate stimuli is probably in itself a variable genetic character which can be inherited.

Parasite variation is shown by the existence of a complex group of varieties, types, strains and stocks for each named bacterium although it is evident that at some time these divisions had their origin in a common ancestor.

It is also pointed out that certain organisms in a new environment will develop new characters, an important variation of this nature being the

development of "drug fastness," as, for example, the training of *T. brucei* in guinea-pigs and rats to withstand doses of tryparsamide fatal to untrained strains, this variation being capable of transmission by inheritance. Such transmissible variations are of supreme importance to epidemiologists as they point to the possibility that the mass treatment of a human herd may produce reservoirs of drug-resistant parasites from which a previously curable disease may be spread in an incurable form.

An additional inference to be drawn from the transmission of such variations is that unicellular organisms, which present a comparatively enormous surface to their external environment, and in which the undifferentiated hereditary chromatin is proportionately exposed to external influences, may transmit acquired characters; Weismann's dogma that such characters cannot be transmitted being, therefore, only true of the higher forms of life in which the germ plasm is continuously exposed to the action of body fluids of almost constant composition.

Nevertheless there is no fundamental difference between bacteria and the higher sexual organisms in the origin of new varieties which are probably all the result of chance gene mutations, the frequency of such mutations being a specific character.

If mutations, then, are frequent in pathogenic bacteria it is possible to believe that many of the phenomena of disease and epidemics may be the results of changes in the characters of the infecting organisms. In the case of *C. diphtheriæ* there are two main variants, namely the virulent and the avirulent, and there can be little doubt but that the latter is frequently a mutant of the former. It is a well-known observation that about two-thirds of the convalescents from diphtheria fail to develop an appreciable quantity of antitoxin in their blood but, since they recover, they must have an efficient anti-bacterial immunity of some kind. Frequently such individuals, who are Schick positives, are subsequently found to be carriers of avirulent organisms probably because avirulent mutants from the original virulent infecting strain have a greater survival fitness in their bodies. Such a hypothesis enables us to understand why, in the observations made at the Greenwich Hospital School: (*a*) carriers of avirulent diphtheria bacilli were found twice as frequently among the boys who were Schick positive as among the Schick immunes; also (*b*) why virulent carrier infection was limited to the Schick immunes; and (*c*) why during a set period the incidence of virulent carrier infection was greater among Schick immunes than was the combined incidence of latent immunizations and clinical diphtheria among the Schick positives.

Further evidence of the replacement of one variety of *C. diphtheriæ* by another has been noted in places where one or other of the mitis, intermediate and gravis variants of the bacillus has apparently disappeared from the area, its place being taken by another of these variants.

Each species of animal has its own particular parasitic fauna and flora and, generally speaking, the diseases of one animal are harmless to another

although there are many well-known diseases, e.g., plague, bovine tubercle and undulant fever, due to cross infection from one species to another.

The filtrable viruses as a class are, however, strictly host specific in this way, the one notable exception to the rule being the virus of rabies which appears to be able to adapt itself to a temporary life in any mammal and to be conveyed by any animal that bites.

In untouched virgin Nature the struggle for existence has reached a stage of equilibrium and gross disease and epidemics are not predominant phenomena, parasitic infection being kept at a steady endemic level by the mutual competition of all the organisms in the same environment, an environment which is supporting the maximum number possible of each species. Man's continual interference with his own environment is perhaps the chief reason of his predilection to epidemics, although his only competitors in the struggle for existence, other than man, are his parasites whose destiny is bound up with his. Where hosts are few, scattered and not increasing in number a parasite which causes so much damage as to limit their capacity for reproducing new hosts will in general be eliminated by natural selection. If on the other hand the density of the host species is great and increasing, the field for invasion by parasites is also increasing and transference from host to host is becoming easier, so that even if a parasite inflicts great damage on its hosts there is little likelihood of its own extermination resulting.

Man is continually devising new methods for lessening the environmental resistance to the existence and increase of the human herd and the majority of men do not require to be very fit to escape elimination by natural selection. Man is therefore not only able to carry a heavier load of disease than other animals, but incidentally, also makes it easier for his parasites to survive.

Reviews.

A SHORT PRACTICE OF SURGERY. By Hamilton Bailey, F.R.C.S.Eng., and R. J. McNeill Love, M.S.Lond., F.R.C.S.Eng. 2nd Edition. London: H. K. Lewis and Co., Ltd. 1935. Pp. viii + 987. Price 30s. net.

This survey of General Surgery has now been issued in one volume instead of two. The result is a volume of convenient size. The illustrations and diagrams are profuse and excellent. We agree with the authors that the subject material is thoroughly up to date and that time-honoured shibboleths have been excluded. All the chapters have been revised and some partially re-written. Advanced surgery and rare conditions have been relegated to small type.

If it were possible we should like to see some of the sections expanded,

such as the treatment of infected wounds, injuries of bone for which 67 pages seem very much on the short side, and burns and scalds for which $1\frac{1}{2}$ pages are very scanty.

It is always a moot point as to how much information is to be obtained from abbreviated operative details in a book of this type. If these were omitted—they can be found in full in operative surgery books which every surgeon must possess—it would give a little more space for general subjects. Sections of special merit are those on intestinal obstruction, appendicitis, subphrenic abscess, infections of the hand and the surgery of nerves.

Errata are few. Those noticed were: p. 51, line 4, "fig. 23," should read "fig. 22"; p. 162, the spelling "phar*a*ngeal" occurs three times (cf. p. 194); p. 254, para. 3, is interposed in the middle of the preceding paragraph; p. 637, line 15, "or" should read "and"

On the whole we have nothing but praise for this work; the greater part of it is really excellent, and the book should be of the greatest value for those reading for the higher surgical examinations and as a book of reference for those engaged in the practice of surgery.

J. M. W.

SURGICAL DISEASES AND INJURIES OF THE GENITO-URINARY ORGANS. By Sir John Thompson-Walker, D.L., M.B., C.M.Ed., F.R.C.S.Eng. Second edition revised. Edited by Kenneth Walker, M.A., M.B., B.C.Cantab., F.R.C.S.Eng. London: Cassel and Co., Ltd. 1936. Pp. xviii + 974. Price 32s. 6d. net.

The appearance of the second edition of this book will be welcomed as an authoritative statement of the views of one so experienced in urology as Sir John Thompson-Walker. The progress of urology during the past twenty years has entailed considerable revision and many additions to the original text. New chapters have been added by Mr. Kenneth Walker on Renal Function Tests, Transurethral Prostatic Resection, Obstruction at the Neck of the Bladder, and Impotence and Sterility. The editor is to be congratulated upon having produced a book which is now thoroughly up to date and well abreast of current established opinion. In a book such as this, which is in every respect so excellent, it is difficult to select parts for special commendation.

The chapter on renal tuberculosis is particulary good. It is pointed out that in a series of 193 cases where nephrectomy was performed by the author for renal tuberculosis, tubercle bacilli were not found in the urine in approximately 20 per cent. This may arise when the number of bacilli is small and their appearance intermittent. Again, it may occur when the focus in the kidney is shut off. Finally guinea-pig inoculation may be negative owing to the bacillus not being pathogenic to this animal. In such cases the diagnosis must be made by symptoms, on the presence of a tubercular lesion elsewhere, the discovery of a thickened ureter, the

presence as shown by X-rays of caseous masses in the kidney, or by the help of cystoscopy. Attention is drawn to the fact that the presence of tubercle bacilli in the urine cannot of itself be regarded as proof of tubercular disease of the kidney. The additional proof required is the presence of pus in the urine, even in microscopic amount.

In the treatment of hæmorrhage after nephrolithotomy, where hæmaturia continues after application of an ice bag, and the administration of morphia and calcium lactate, it is advised to open up the incision in the kidney, flush out with hot lotion, introduce a tube into the pelvis and pack around it with gauze. It is said that this treatment usually suffices to control the hæmorrhage.

In the section dealing with the prostate a short description is given of Harris's method of prostatectomy in which primary closure of the bladder is performed. It is pointed out that the method is still on trial but that the results have been encouraging in good risk subjects capable of withstanding primary prostatectomy.

The chapter devoted to transurethral prostatic resection is excellent and a clear description is given of the operative technique and special instruments employed. It is pointed out that the key to perurethral work on the enlarged prostate is the careful selection of cases and that the abuse of this method by enthusiasts has sometimes brought it into disrepute and caused its value to be lost sight of. It is recommended for cases in which the vesical rather than the urethral aspect of the prostate is affected, e.g. obstruction by an enlarged middle lobe. It is also recommended for the small fibrotic prostate and for those cases where total prostatectomy is contra-indicated either on account of the poor general condition of the patient or the presence of intercurrent cardiac, renal, or pulmonary disease. It is not recommended for cases where the lateral lobes are mainly affected. Emphasis is laid on the necessity for accurate estimation of the degree of intravesical enlargement in deciding whether a case is suitable for the perurethral operation, and to avoid mistakes the use of the resectoscope, designed by Mr. Ogier Ward, is advised. As regards the type of perurethral operation to be employed, the writer favours resection by means of an activated loop rather than coagulation with or without punching.

A brief but nevertheless complete account is given of gonococcal infection of the urethra, prostate and vesicles. It is significant that the writer will have nothing to do with the conception of a gonococcal urethritis localized to the anterior urethra—the posterior urethra being infected in 80 per cent to 90 per cent of cases. Similarly, he obviously looks with disbelief upon those who maintain that non-gonococcal urethritis is a common condition. His opinion is that it is rare and the more refined the methods of examination, especially cultures and the complement fixation test, the fewer become the cases of non-gonococcal urethritis.

A most valuable part of the book is the list of references given at the end of each chapter. These are well chosen and not too numerous.

The book is clearly printed and the illustrations are numerous, well-reproduced, and thoroughly up to date.

It is impossible to do anything but praise this book. As a standard work of reference it will take a recognized and leading place.

D. McK.

SYNOPSIS OF SURGICAL ANATOMY. By Alexander Lee McGregor, M.Ch.Edin., F.R.C.S.Eng. Third edition. Bristol: John Wright and Sons, Ltd. 1936. Pp. xii + 664. Price 17s. 6d. net.

This is a useful book, the main object of which is to present concisely the facts of surgical anatomy so that they are readily available for the surgeon, the student and the practitioner.

There is a very large amount of matter in the book and the author includes many of the more rational theories of pathological conditions. The diagrams are plain and make easier the reading matter to which they refer; there are a large number of these diagrams, more than normally found in a book which is only intended for a synopsis. The print is large and legible and well arranged, and the book is well indexed. The subject matter, as is to be expected in a work of this type, is brief and to the point, but at the same time all the facts are presented and the reader is free to make his choice although the author indicates what facts, in his opinion, are most important.

Useful chapters are given at the end on the "Anatomy of Surgical Procedures" which point out the technique of individual operations—the pitfalls to avoid, the anatomy of the incision, etc.

This book should be a very useful work of reference to any doctor, but particularly to the surgeon as there is very little information that will not be found between its covers.

Notices.

THE ALEXANDER MEMORIAL PRIZE.

MAJOR J. BIGGAM, M.C., R.A.M.C., has been awarded the Alexander Memorial Prize for the year 1935, consisting of a gold medal and a sum of £40.

The Alexander Memorial Prize is awarded annually to an officer of the Royal Army Medical Corps for professional work of outstanding merit.

THE LEISHMAN MEMORIAL PRIZE.

MAJOR J. S. K. BOYD, R.A.M.C., has been awarded the Leishman Memorial Prize for the year 1935, consisting of a silver medal and a sum of £30.

The Leishman Prize (Officers) is awarded annually to an officer of the Royal Army Medical Corps or the Army Dental Corps for work of outstanding merit.

NORTH PERSIAN FORCES MEMORIAL MEDAL.

A. A. Forbes Brown, Esq., M.D., D.T.M. & H., Colonial Medical Service, has been awarded the North Persian Forces Memorial Medal for the year 1935 for his paper on "The Ulcer Syndrome in Tropical Africa," published in the *Journal of Tropical Medicine and Hygiene*.

The North Persian Forces Memorial Medal is awarded annually for the best paper on Tropical Medicine or Hygiene published in any Journal during the preceding twelve months by a Medical Officer, of under twelve years' service, of the Royal Navy, Royal Army Medical Corps, Royal Air Force, Indian Medical Service, or of the Colonial Medical Service.

THE PARKES MEMORIAL PRIZE FOR 1936.

Owing to recent alterations in the conditions governing the award of the Parkes Memorial Prize, this prize, consisting of a gold medal and £30, will in future be awarded annually to " such person being a regular serving medical officer on full pay of the Naval, Military, or Indian Medical Services as, in the opinion of the Committee, has by professional work of outstanding merit done most for the advancement of Naval or Military Hygiene."

The first prize under the new regulations will be awarded for the year 1936.

The names of officers recommended for this prize should be submitted through the usual channels so as to reach the Honorary Secretary, the Parkes Memorial Fund, Royal Army Medical College, Millbank, S.W.1, on or before October 31, 1936, together with a short account of the work on which such recommendation is based.

By order of the Committee of the " Parkes Memorial Fund."

F. Harris,
Major, R.A.M.C.,
Honorary Secretary,
Parkes Memorial Fund Committee.

Royal Army Medical College,
Millbank,
London, S.W.1.

INTERNATIONAL CONGRESS OF MILITARY MEDICINE AND PHARMACY.

The Permanent Committee of the International Congress of Military Medicine and Pharmacy informs us that the Sixth Session of the *Office International de Documentation* of Military Medicine will be held at Geneva from October 12 to 14 next.

All officers of the Medical Services of the Army, Navy, Air Force and Colonial Services are invited to participate in the Congress.

For further information application should be made to the Secretary General: Colonel Médecin Voncken, Liége, Belgium.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

Correspondence on matters of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a nom-de-plume.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts in the case of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Reprints or excerpts, additional to the above, can be furnished on payment if specially ordered at the time of submission of the article for publication.

Communications in regard to editorial business should be addressed—"The Editor, Journal of the Royal Army Medical Corps, War Office, Whitehall, London, S.W. 1."

MANAGER'S NOTICES.

The Annual Subscription for the Journal of the Royal Army Medical Corps is £1 payable in advance. Single copies, 2s. 6d. per copy.

Cheques, etc., should be made payable to the "Journal R.A.M.C.," and crossed "Holt & Co."

Each subscriber who pays his subscription direct to the Manager will also receive monthly a copy of "The R.A.M.C., The A.D. Corps, and Q.A.I.M.N.S. *News and Gazette.*"

Communications in regard to subscriptions, change of address, etc., should be addressed "The Manager, Journal of the Royal Army Medical Corps, A.M.D.2, War Office, Whitehall, London, S.W. 1."

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The above is an extract from an interesting pamphlet we have just issued concerning Cystopurin. A copy of this, with clinical samples of Cystopurin, will gladly be forwarded on request to

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ISSUED MONTHLY

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CONTENTS.

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LIEUTENANT-GENERAL SIR ALFRED KEOGH,

G.C.B., G.C.V.O., C.H.

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Journal
of the
Royal Army Medical Corps.

Obituary

LIEUTENANT-GENERAL SIR ALFRED KEOGH, G.C.B., G.C.V.O., C.H.

[This obituary has been written by Major-General Sir Michael Russell, K.C.M.G., C.B.]

SIR ALFRED KEOGH was born in Dublin on July 3, 1857. His father was a member of the Irish Bar and Resident Magistrate of Roscommon. He was educated at Queen's College, Galway, and at the age of 21 took his medical degrees at the Royal University of Ireland. Coming then to London he obtained a resident appointment at the Brompton Hospital for Consumption, and was for a time a Clinical Assistant at the Westminster Ophthalmic Hospital. In 1880 he entered the Army Medical Service and at Netley distinguished himself by taking the Herbert Prize and the Martin Memorial Gold Medal. After a period of service abroad he returned home and was appointed Medical Officer to the Royal Arsenal at Woolwich.

In 1900 he was promoted Lieutenant-Colonel and the same year was specially selected for increased pay of the rank for his services in South Africa. On December 2, 1904, he was promoted Colonel and on the following day Surgeon-General; and on January 1, 1905, Surgeon-General ranking as Lieutenant-General on being appointed Director-General, Army Medical Services. He remained Director-General from January, 1905, to March, 1910, when he went on retired pay. In October, 1914, he was reappointed Director-General shortly after the outbreak of the Great War and remained so until 1918.

Sir Alfred Keogh will be long remembered as a great administrator.

He had all the requisites for the task. Quick perception of essentials, tenacity, enthusiasm and rapid action characterized all his work. His judgment was rarely at fault; it has been described as intuitive. Intuition there was; but it was founded on knowledge, wide reading and close observation.

In his younger days he devoted himself to acquiring a sound professional ground work, taking clinical appointments in general and special hospitals, and losing no opportunity of adding to his store. This professional keenness he kept up through his working life. I well remember how deeply interested he was when once on leave at Berne we paid a visit to Kocher, then on the crest of the wave of his European reputation. It was difficult to see which was the more absorbed, Kocher in demonstrating the work in his clinic or Keogh in eliciting all the information he could.

On joining the Army, without loosening his grasp on his purely professional work, Keogh immersed himself in the study of military medical problems. He familiarized himself with the various Commissions which had reported on the subject—especially the Herbert, Camperdown, and Elgin reports. In these, he would say, are laid bare most of the spots where the shoe pinched.

One of his great ambitions was to break down the barrier which existed between the civil and military branches of the profession. This was difficult so long as the military training centre was isolated at Netley; but when he reached higher administrative rank the opportunity came and he seized it with both hands. By great good fortune the Secretary of State for War at the time (Mr. Broderick, now Lord Middleton) was sympathetic and the Royal Army Medical College was built and opened in London. Thus the way to the co-operation of the civil and military branches of the profession, which has since proved of such great advantage, was opened. In this connexion the help that the then Advisory Board was able to give, and gave, should not be overlooked.

In this College the post-graduate instruction for Captains for promotion to Major was expanded to nine months and the students were given the advantage of participating in the instruction given in the London schools and hospitals—and of training for specialties which they might wish to adopt.

When the Territorial Force was established by Mr. Haldane (later Lord Haldane) it became necessary to organize its Medical Service. This was more of a creative effort than an organization, as the medical units required for the Force did not exist, and the few medical units in being bore no relation to it.

By visiting the chief medical centres in the Kingdom and expounding the meaning of, and the necessity for, these units, Keogh enlisted the co-operation of the leaders of the profession. The units were established, and courses of instruction were instituted; so that in 1914, when the War broke out, the great hospitals came into being without trouble and the

sick and wounded were assured of the ministration of the cream of the medical profession throughout the land.

Another reform was the reorganization of the military hospitals at home. At the time he took over the office of Director-General every little depôt station had its little hospital with a skeleton staff, in which cases of sickness occurring in the station, serious or slight, were supposed to be treated. These tiny hospitals were closed down, and all cases requiring hospital treatment were transported to the nearest well-equipped hospital, where they could obtain the nursing and attention they required.

A subject on which Keogh held strong and clear views was sanitation. His views did not at first meet with general acceptance, but they prevailed in the end. He held that the real sanitary officer of a unit was the Commanding Officer not the Medical Officer. The preservation of the health of his men should be one of the main preoccupations of the Commanding Officer; the Medical Officer was there as an expert, to advise and to be consulted, but the ordinary rules of hygiene should be known to and enforced by all officers. For that reason it was necessary that they should all be instructed in these matters. Hence arose the School of Army Sanitation and the teaching the elements of Hygiene embodied in the Manual of Army Sanitation to all officers.

Shortly after laying down his office as Director-General he was appointed Rector of the Imperial College of Science and Technology. This was a congenial post as his interests in Science had always been deep and close, and he welcomed the opportunity of extending its practical application. What he valued highly was the personal association into which he was brought with leading scientists, and with the students being educated at the College for scientific careers. With his keen sympathy for youth he was always on the look out for measures which might enhance or ease the course of training.

When the War broke out it was felt that his services were required in the military sphere. The British Red Cross Society, mindful of the way he had always encouraged and helped them during his tenure at the War Office, appointed him their Chief Commissioner in France and there he remained until October, 1914, when he was recalled and reappointed Director-General, Army Medical Services, at the War Office.

There he was able to see the reorganization of the Military Medical Service, which he had carried through in his previous tenure, come to fruition. The great machine started and worked without a hitch. There was complete and loyal co-operation between the civil and military sides. All had been made to understand and laboured sympathetically to a common end. And so, with his hand on the lever, the machine continued to work until the close.

A great triumph, which was universally acknowledged. At the conclusion of the War all vied to do him honour.

At home he was made G.C.B. (the first Army Medical Officer to be given

that honour), G.C.V.O. and Companion of Honour; France made him Grand Officer of the Legion of Honour; Belgium Grand Officer of the Order of the Crown; Servia Grand Officer of the Crown, White Eagle; the Universities of Oxford, Edinburgh, Aberdeen and Leeds gave him honorary degrees; the Royal Colleges of Surgeons of England, Edinburgh and Dublin gave their Honorary Fellowships; and thus amidst a chorus of appreciation he returned to his work at the Imperial College of Science and Technology.

As a man he was entirely likeable. Quiet, kindly and sympathetic in manner, no trouble was too great for him to help a friend or anyone who applied to him for advice or assistance.

He possessed in a high degree the faculty of clear exposition and admired it greatly in others. He has told how, at times when working in London, he would steal off to the Law Courts to listen to some leading barrister presenting his case. A very distinguished retired official who did some work for him during the War once said of him: "In a long official career I have served many masters; but two stand out pre-eminently. Each had the power of stating lucidly not only what he wanted done but also of indicating categorically how he wanted it done. There was never any ambiguity. One was Lord Curzon of Kedleston and the other Sir Alfred Keogh."

A hard worker himself Keogh expected hard work of those under him but he never failed to acknowledge such work with a kindly smile or a few words of appreciation, and took care that the credit went to the doer. Amongst those who worked under him Keogh inspired feelings of intense loyalty and often of affection.

His work is done but his memory will long remain green amongst those who knew him.

Appreciation.

By Lieutenant-General Sir JAMES A. HARTIGAN, K.C.B., C.M.G., D.S.O., K.H.P.
Director-General, Army Medical Services.

ALTHOUGH Sir Alfred Keogh was personally unknown to the majority of serving officers of the Corps, the striking tributes paid to his memory in the Press have been, I feel sure, a source of much gratification to all its past and present members.

Until the last couple of years of his life my acquaintanceship with him was limited to a single meeting in the South African War when I took a convoy of sick and wounded to the General Hospital which he commanded at Pretoria and when as a subaltern I was much impressed by the courtesy and hospitality which he showed me. I had since heard so much about him from officers who knew him well that I had come to regard him as one of the most outstanding officers of our Service.

When, some two years ago, I heard that he had returned to London

(he had been living abroad) I called on him, a very simple act of courtesy from a Director-General to the greatest of his predecessors. He was frankly pleased, and such was the modesty of the man that he seemed surprised to learn that his services were still remembered and appreciated. He invited me to visit him frequently and this invitation I took full advantage of, sometimes in order to seek his advice which he gladly gave. I shall always entertain the happiest recollections of these visits. Seated on a chair with a rug over his knees, he would recount his experiences during the two periods in which he was Director-General—probably two of the most important periods in the history of the British Army as they were assuredly the most important in the history of the R.A.M.C.

The transfer of the College from Netley to Millbank; the organization of the Territorial Army Medical Service; the establishment of the School of Hygiene; the development of the clinical and scientific side of the Corps; liaison with the civil profession; his interview with Lord Kitchener before returning to the War Office for the second time—these were some of the topics which he related to me and which I found of absorbing interest. I invariably came away from these visits with the feeling that I had been in the presence of a great man.

He retained the keenest interest in the Corps to the end; in fact, when speaking of it, he was inclined to forget he was an invalid (he was prone to anginal attacks) and allowed himself to be carried away by his enthusiasm. Before returning to take up the duties of Director-General during the War he asked for, and was accorded, exceptional powers, without which he could not have carried out that stupendous task.

It is well known that his position at the War Office was somewhat unique. With Mr. Haldane (afterwards Lord Haldane) he was on terms of close intimacy. Their outlook and ideas had much in common and he always expressed the warmest regard and affection for that great statesman. With Lord Kitchener too he worked in the greatest harmony.

The sympathy of the whole Corps will go out to Lady Keogh and her family at the irreparable loss they have suffered and the nation in general, and we of his Service in particular may feel grateful that at the time of our greatest trial the post of Director-General was held by the officer who was so pre-eminently qualified to fill it.

Original Communications.

PERCHLORIDE OF MERCURY AS A STERILIZING AGENT FOR BACTERIAL SUSPENSIONS.[1]

By Lieutenant-Colonel R. F. BRIDGES,
Royal Army Medical Corps.

Introductory.

So far as laboratory workers in India are concerned, the recognition of the Newcastle type of dysentery bacillus by bacteriologists at home (Clayton and Warren, 1928, 1929; Downie, Wade and Young, 1933; Whitehead, 1934), and its subsequent finding in India has been no unmixed blessing. This organism, as is now well known, gives biochemical reactions which differ in important respects from those found in the Flexner and Boyd (1931, 1932, 1936) groups of bacilli. The Newcastle type ferments glucose and dulcite (late), and sometimes also mannite, with production of acid and gas, and yet serologically is found to be indistinguishable from the Boyd type 88 (Scott, 1934).

Until recently, whenever an organism, isolated from the stools of a dysentery case, showed gas formation in any of the sugar media, it could be discarded at once, without further test, as not belonging to any of the known dysentery groups. But in view of the presence in India of the Newcastle type, this simple method of differentiation can no longer be relied upon. Many organisms, which formerly were discarded on their biochemical reactions, must now be tested by serological methods before their identity with type 88 or the Newcastle bacillus can be established or disproved.

During the investigation of organisms on the above lines, there have been found in several laboratories strains which, while differing in their biochemical reactions from those associated with the Flexner and Boyd groups, yet are agglutinated strongly—it may be even to full titre—by the serum prepared from one of the type strains other than type 88. In these cases there has been a tendency to identify the organism with the type strain concerned, in spite of their differing biochemical reactions. Such conclusions are, of course, unjustified: in every case in which these organisms have been subjected to further investigation by absorption tests, their dissimilarity to the type strains has at once become apparent.

The question as to how far it is permissible to diagnose organisms on the results of simple one-sided agglutination tests, or even on one-sided absorption tests, is one which cannot be discussed here. But it may be stated, as an absolute rule, that no organism which shows unusual biochemical reactions should be regarded as identical with one of the Flexner

[1] A paper circulated to the military laboratories of India.

or Boyd types until it has been completely investigated by mirror absorption tests.

These matters have been referred to in order to show that the work now involved in the examination and typing of dysentery bacilli has enormously increased during recent months; and, further, to point the moral, that any method which can in any degree lighten this labour is worthy of sympathetic trial. The method to be described has been in use in the Enteric Laboratory, Kasauli, for some time past, and has given consistently good results. It is recommended with confidence to other laboratories.

Nature of the Method.

A concentrated suspension of the organism under test is prepared in a 1 : 1,000 solution of perchloride of mercury in physiological saline solution, and this suspension is used for all tests: for rough agglutination on a slide, for simple agglutination tests, and for absorption tests.

Perchloride of mercury has the advantage that the organisms are killed outright by contact with the drug, and the suspension may be handled with safety. The extremely poisonous nature of the solution itself must not, of course, be overlooked.

Preparation of the Suspension.

The perchloride of mercury is made up as a 1 : 100 solution in distilled water, and the 1 : 1,000 solution is prepared from this by diluting one volume with nine volumes of physiological saline solution. Both solutions keep indefinitely.

To a well grown twenty-hour-agar slope add a small quantity of the 1 : 1,000 perchloride solution, and wash off the growth into the fluid. The amount of solution used must be such that the resulting suspension is denser than the standard. About one cubic centimetre is suitable for an agar slope of normal size.

Pipette off the suspension into a clean test tube. The organisms are dead.

If rough and simple agglutination tests only are to be carried out, two agar slopes are sufficient. If an absorption test is required in addition, five agar slopes should be inoculated.

Standardization of the Suspension.

The standard density to be adopted is that of the Proteus suspensions supplied for Weil-Felix test. For rough agglutination and for simple agglutination standardization need not be more than approximate. Those who have worked with the Proteus suspensions should have no difficulty in recognizing the appearance and density of a drop as it falls from a pipette. The concentrated suspension should be diluted with 1 : 1,000 perchloride solution until a drop acquires this appearance. It

may be described as that point where the drop has lost its distinctly white colour and has acquired a greyish, translucent, opalescent appearance.

For absorption tests standardization must be more exact, since the absorbing dose is accurately proportioned to the strength of the serum and there is little to spare. On no account should the concentrated suspension be of less density than the Proteus suspensions, though it may be of slightly greater density with advantage. Standardization may be carried out by simple matching method, as follows :—

Take a Dreyer's rack and place one agglutination tube in the back row. Fill this tube to half an inch from the brim (the mark) with saline, and add one drop of Proteus suspension. This tube acts as standard.

Place five tubes in the second row and fill to the mark with saline. Place five tubes in the front row and to each add three drops of the concentrated suspension to be standardized. To the first tube in the front row add one drop of saline, to the second tube two drops, and so on to five drops in the fifth tube. Mix the contents of these tubes and add one drop from each to the corresponding tube in the second row. Match these tubes against the standard. Supposing that a match is obtained in the fourth tube, then three volumes of concentrated suspension must be diluted with four volumes of perchloride solution to bring to standard density.

Rough Agglutination Test.

The test should be carried out on slides with a hollow depression rather than on plain slides. But since it will generally be necessary to carry out tests with a number of serums, the most convenient form of apparatus is one of the large glass plates, obtainable from Messrs. Baird and Tatlock, containing six or twelve depressions.

Place a drop of each of the serums to be tested in one of the depressions, and add to each one drop of concentrated suspension. Agitate the plate with a circular motion and examine the drops with a hand lens. In a positive test agglutination should be visible in two or three minutes.

Simple Agglutination Test.

This is set up in the same manner as when using concentrated suspensions of Proteus organisms. The serum, diluted 1 : 10, is added to the tubes (10, 5, 2, 1, etc., drops) in the ordinary way. All tubes are filled up to the mark with saline and one drop of concentrated suspension is added to each tube.

Incubation should be carried out for four hours in the water bath at 50° to 55° C., followed by all night in the 37° C. incubator. On the following morning return all racks to the water bath for a few minutes before reading the test.

Absorption Test.

The standard strength of serum to be employed is such that it will show agglutination against its homologous freshly-prepared concentrated

suspension to a titre of "total" in 250, equivalent to "standard" in 350. Since the majority of serums supplied by the Enteric Laboratory are much above this strength, an essential preliminary is to test the serum against its homologous concentrated suspension and reduce to the above strength. This may be accomplished as follows :—

If the serum agglutinates its homologous concentrated suspension to "standard" in 500, dilute 2 drops of serum with 1 drop of saline. If the titre is "total" in 500, dilute 1 drop of serum with 1 drop of saline. If the titre is "standard" or "total" in 1,000, dilute 1 drop of serum with 2 or 3 drops of saline respectively.

It may sometimes be found that the type serum agglutinates the organism under test to a higher titre than the homologous suspension. In this case, since it is inadvisable to reduce the homologous titre below 350, a stronger concentrated suspension, must be used for absorption. Its strength should be increased in proportion to the titre. Thus, if the serum agglutinates the unknown organism to "total" in 500, a double strength concentrated suspension should be used; if to "total" in 1,000, its strength should be quadrupled.

To carry out the absorption, place 4 drops of serum of standard strength in a Dreyer's dilution tube, and add 76 drops of concentrated suspension of the organism under test. Mix well with a pipette, cap the tube with plasticine to prevent evaporation, and place in the incubator overnight.

On the following morning spin the tube in the centrifuge until the supernatant fluid is comparatively clear. This will generally take only a few minutes. Pipette off the supernatant fluid into another tube. If no centrifuge is available, allow the tube to stand on the bench for two or three days, when the organisms will have become deposited and the supernatant fluid can be pipetted off.

Set up the test as follows : Place five tubes in each of two rows in a Dreyer's rack. To the first tubes in each row add 20 drops of absorbed serum ; to the second tubes, 10 drops ; to the third and fourth tubes, 4 and 2 drops ; and to the fifth (control) tubes, no drops. Fill up all tubes to the mark with saline.

To all tubes in the first (test) row add one drop of concentrated suspension homologous to the serum. To all tubes in the second (control) row add 1 drop of concentrated suspension of the organism under test. The dilutions are equivalent to 1 : 25, 50, 125 and 250.

Incubate as for a simple agglutination test and watch for agglutination. The results are read as follows :—

(1) If no agglutination occurs in the control row, the test is satisfactory.

(2) If agglutination occurs in the control row, the absorbing dose has been insufficient. The test must be repeated, using a stronger concentrated suspension for absorption.

(3) If no agglutination occurs in the test row, the organism under test has removed the whole of the homologous agglutinin from the type serum and hence is probably identical with the type organism.

(4) If agglutination occurs in the test row, the organism has failed to remove the homologous agglutinin and hence is not identical with the type organism.

N.B.—No two organisms can properly be regarded as serologically identical until it is proved that each can absorb the homologous agglutinin from the serum of the other.

Recording Results.

It is perhaps not out of place to suggest methods which may be agreed upon for recording results.

In the case of a rough agglutination, results are commonly shown as + + +, + +, + or −, according to the strength or otherwise of the reaction.

In the case of simple agglutination test, results are conveniently written as equations. The serum is always placed first. This is followed by the suspensions against which the serum is tested and then by the titre. Thus, if a serum prepared from an organism A is tested against its homologous suspension and also against that of another organism B, the results would be written :—

$$A \quad v. \quad A = 350$$
$$A \quad v. \quad B = 250$$

Or the homologous titre may be placed in brackets after the serum, and the above tests would then be written :—

$$A\ (350) \quad v. \quad B = 250$$

For recording the results of absorption tests, the absorbing organism is placed directly after the serum and preceded by the minus sign. This is followed by the suspension against which the serum is tested after absorption and the titre obtained, thus :—

$$A—B \quad v. \quad A = 125$$
$$A—B \quad v. \quad B = \text{Nil}$$

Notes on Some Matters of Importance.

Standardization of the Suspension.

The Proteus suspensions, against which the concentrated suspension is matched, are standardized to a density equivalent to 6,700 million *Bact. coli* per cubic centimetre. The method of carrying out this standardization was described in a previous paper (Bridges, 1935).

The Agglutination Test.

In the paper referred to above the view was put forward that the result of an agglutination test depended on the quantity of serum and the number of organisms present in any particular tube of a test, rather than on the dilution in which the serum was working. "Dilutions" were thought to be of a clinical rather than of real significance, and hence exact measurement of the saline added to each tube was unnecessary. It has been

represented that this unmeasured saline method of setting up a test is such a break with tradition that some further explanation is desirable.

Careful tests have been made to decide what error might be expected in setting up a test by this method. At the time these tests were carried out, the laboratory possessed a very heterogeneous collection of agglutination tubes, which were well suited to the purpose. A number of these tubes were marked at a point half-an-inch from the brim and, using throughout a single pipette, the number of drops they contained to this mark was counted. It was found that the tubes varied in capacity from 20 drops in those of the smallest internal diameter, to 28 drops in those of the largest bore. Two sets of tubes were then collected of these extreme capacities—the one set containing 20 drops, the other set 28 drops, when filled to the mark.

It is clear that the error in dilution as between the two sets of tubes was as 5 is to 7, and if the error in reading followed the error in dilution, it should observe the same proportion. In the course of a number of tests the actual error was found to be as 5 is to 5·7,[1] considerably less than the error in dilution. This would mean, in the case of a patient whose serum was being tested against a standard suspension, that the titre might reach 500 in the one set of tubes as against a reading of 570 in the other set. It can hardly be contended that this difference would lead to a wrong diagnosis. Moreover, the tests were conducted in tubes of extreme disproportion. In an ordinary set of bad tubes the error would be decidedly less.

Nevertheless, it is true that error should be eliminated if possible, wherever found and however small, and this can be done by providing oneself with a set of pipettes and tubes of standard dimensions. In the past—in India at any rate—there has been considerable difficulty in obtaining satisfactory pipettes and tubes for agglutination work. The various makers or purveyors of these materials seem quite unable to standardize them, either among one another or even in relation to the products of a single firm. Pipettes deliver too large or too small a drop and tubes are of uneven capacity. Under these circumstances it has been found necessary, in self defence, to adopt a standard of one's own. This standard is based on a Dreyer's pipette of Baird and Tatlock's manufacture, which has been in one's possession for a number of years. On measuring the external diameter of the outlet of this pipette, it is found to lie between 12 and 13 "standard wire gauge" measurement, being nearer the latter than the former. It passes easily, with something to spare, through 12 standard wire guage, but it fails to pass through 19.

This pipette having been adopted as standard, the tubes must conform, i.e., they must hold twenty-four drops delivered by the standard pipette to a point half an inch from the brim. It is found that a tube of 2¼ in.

[1] Strictly, of course, the error between the two sets of tubes should read "as 5·7 is to 5."

length and having an internal diameter of 5 standard wire guage exactly meets this condition.

For some time past any pipettes or tubes which depart appreciably from the above standards have been returned to the makers with a note as to the reason. As a result of this policy the laboratory is now provided with a set of pipettes and tubes, in the use of which the error is believed to be so small as to be negligible.

It is, of course, open to anyone who still hesitates to use this method, through inability to obtain standardized glass ware, to overcome the error by other means. He should use only one pipette for all his tests, be careful not to break it, and mark all his tubes at the point where they hold twenty-four drops.

The Absorption Test.

If it be conceded that the essential factors in an agglutination test are the actual quantity of serum and the number of organisms present in the tubes, then it is only one step further to regard an agglutination test as a form of absorption test, in which diminishing quantities of serum are absorbed by a constant number of organisms. When the quantity of serum has been reduced to such an extent that its agglutinin is exactly neutralized by the organisms present, the end-point or titre of the serum has been reached.

In the test as ordinarily set up there are placed in the first tube ten drops of serum diluted 1 : 10. Hence the actual quantity of serum present in this tube is one drop. In the second tube there are placed five drops of diluted serum, and the actual quantity of serum is therefore 0·5 drop. In the third and fourth tubes there are 0·2 and 0·1 drop of serum respectively. To all tubes is added one drop of concentrated suspension.

If, now, we consider a serum which has its end-point in the fourth tube, or, as we say, has a titre of 250, it may be supposed that 0·1 drop of this serum will be exactly absorbed by one drop of suspension. From this we may assume that one drop of this serum would require for its absorption ten drops of suspension—and in fact this is found to be the case. Similarly, a serum having a titre of 500 will be absorbed by twenty drops of suspension for each drop of serum. Intermediate between these two, a serum of titre 350 will require an absorbing dose of fourteen drops for each drop of serum. Intermediate between these two, a serum of titre 350 will require an absorbing dose of fourteen drops for each drop of serum. In the absorption test recommended in this paper a dose of nineteen drops is given for a serum of this strength. There is thus a surplus of five drops above the requisite number, a sufficient but not excessive margin. To increase this margin would merely result in prolongation of the time required for centrifugalization after absorption.

Keeping Properties of Concentrated Suspension.

No long term investigation has been carried out on this matter. It is known that concentrated mercurialized suspensions, prepared in accordance

with the directions given, retain their agglutinating properties well for two or three months, and during this period lose no more in sensitiveness than other forms of preserved material. But they tend to lose density, and also in some cases to form a black deposit at the bottom of the bottle. It is doubtful if they would be suitable for any long course of investigation in which a standard agglutinable material might be required.

Applicability of the Method.

This paper is particularly concerned with the differentiation and typing of organisms isolated from cases of acute bacillary dysentery; but the method is equally suitable for the investigation of other non-motile bacilli. It may also be applied in connection with the "H" antigen of motile organisms. In this case, however, agglutination and absorption are dependent on the presence of flagella, a component of the bacillus which is represented in very varying quantity in different races of the same organism. Moreover, flagella cannot readily be counted or standardized, as is easily possible in the case of the bacterial bodies themselves. These facts render necessary some modifications of technique, which must be dealt with in a later communication.

SUMMARY.

(1) A method is described for the rapid identification of dysentery bacilli.

(2) The possible error in setting up an agglutination test by the unmeasured saline method is discussed.

(3) The theoretical basis of the absorption test carried out with concentrated suspensions is explained.

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TYPHUS FEVER IN THE SIMLA HILLS.

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This distressing and sometimes fatal disease again appeared in the Simla Hill Stations during 1935. In his paper describing this fever, Macnamara (1935) reported the following incidence among Europeans: 1932, 5 cases with 2 deaths; 1933, 14 cases with 1 death; and 1934, 15 cases with no deaths. The definite seasonal incidence noted by Macnamara was apparent in the present series of six cases, all of which became ill between September 12 and 22, towards the end of the rainy season. None of the patients gave a history of bites by any insects, but all, with the exception of Case 5, admitted to having walked or sat in grass on the hill-sides. None of the patients remembered seeing rats in the neighbourhood of their barracks, or vermin of any sort in their clothing. Case 5, an Indian cook, when asked if he ever went for walks, replied: "No Sahib, why should I?"

Though not concerned with epidemiology in this paper, one wonders to what extent the following factors contributed to the low incidence of the disease in 1935, as compared with the two previous years:—

(i) The late onset of the monsoon, July 7, as compared with June 16 in 1933 and 1934.

(ii) The occurrence of a break in the monsoon of nine days without rain from August 22 to 30 inclusive. The only comparable spell of fine weather during the monsoons for the last four years was July 20 to 24 (five days) in 1934.

(iii) The publication in June, 1935, of the following Ambala Brigade Area Order on the advice of the medical authorities:—

"Precautions Against Typhus Fever.

"All ranks are warned against the danger of contracting typhus fever, which recurs every year in this area during the monsoon period.

"The reservoir of this disease is believed to be rats, field mice, squirrels, etc., from which the disease is conveyed to man by the bites of blood-sucking parasites such as ticks, fleas and mites. These parasites are normally present in the above animals, but during the monsoon period they migrate from their hosts and come to live upon grasses and plants, on the juices of which they feed. They remain infective, however, and are liable to give rise to the disease in man, should they bite him.

"Jungle country, where there is much damp undergrowth, is especially dangerous and should be avoided as far as possible. On no account should individuals pass through such country with their limbs bare.

"(To be republished in Unit Orders.)"

TABLE I.—LIST OF CASES.

Case No.	Nationality	Infected in locality	Admitted hospital	Rash appeared	Duration of fever
1	British	Solon	16.9.35 (4th day of disease)	Nil	21 days
2	,,	,,	22.9.35 (7th ,, ,,)	10th day	17 ,,
3	,,	Dagshai	18.9.35 (3rd ,, ,,)	11th ,,	15 ,,
4	,,	Kasauli	24.9.35 (3rd ,, ,,)	6th ,,	16 ,,
5	Indian	,,	13.9.35 (1st ,, ,,)	Nil	15 ,,
6	,,	Nalwa, near Kasauli	20.9.35 (8th ,, ,,)	Nil	Died 20th day

It is proposed to present short case reports, the laboratory findings, temperature charts and a summary of the dominant symptoms. During convalescence three British patients were asked to write their recollections of the onset of their illness. The results are considered sufficiently graphic and entertaining to warrant their inclusion at the end of their respective case reports. These accounts are exactly as written by the patients, unaltered in any way, and are good examples of the high order of intelligence shown by the present-day soldier.

Case 1.—Lance-Corporal C., aged 24, 1st Dorset Regiment, arrived at Solon from Sialkot on August 17, 1935. There was no past history of malaria and during his two years' service in India he had suffered from protozoal dysentery in April, 1934, and acute pharyngitis in June, 1935.

When admitted to hospital at Solon on September 16 he complained of severe headache of three days' duration, fever and shivering attacks. These symptoms continued until September 21, when he was transferred to Kasauli, and on this date there was noted slight stiffness of the neck and a small enlarged non-tender gland in the anterior triangle on the right side. Examination of eight blood-films had failed to demonstrate malaria parasites. No abnormalities were detected in the urine.

White cell counts were as follows:—

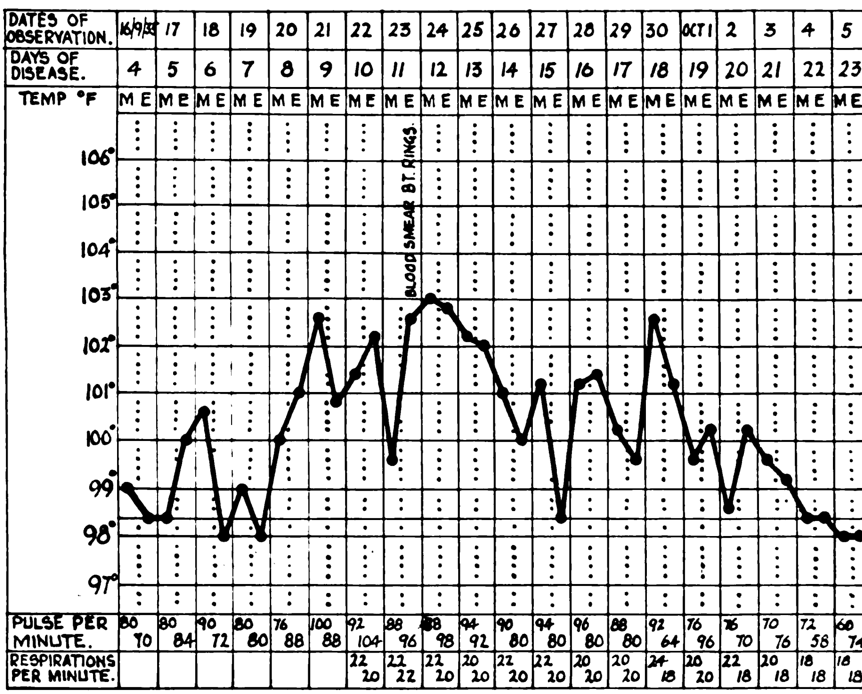
September 19: Total count: 6,000 per cubic millimetre. Differential count: polymorphs 65 per cent, lymphocytes 25 per cent, mononuclears 6 per cent, and eosinophils 4 per cent.

September 20: Total count: 5,000 per cubic millimetre.

On September 22 examination showed a dark-complexioned man with flushed face and injected conjunctivæ, lying flat on his back and perfectly still. He was mentally alert, was very disinclined to move his head or eyes, yet willingly moved himself for examination. His great complaint was headache, aggravated by movement of his eyes, and to a less extent photophobia. He also complained of pain in the back of his neck and across his shoulders, anorexia and thirst. He had a slight restrained cough and sore throat. His tongue was coated on the dorsum with thick yellow-white fur, the edges and tip being clean. His fauces, pharynx and soft palate showed considerable congestion without rash or exudate. Slight non-tender enlargement of the lymph-glands below the angles of the jaw was noted. The neck rigidity noted on the 21st was no longer evident. Blood-films were again negative and the urine contained no albumin or sugar.

On September 23 (eleventh day of illness) a few scattered benign tertian ring forms were discovered in blood smears. Quinine, twenty-four grains three times a day, was given and continued for ten days without effect on the temperature. This morning he complained of rather severe deep-seated pain in the right chest above the costal margin. This pain did not appear to be related to deep respiration or coughing, and in the course of the next two days moved gradually across the front of the chest to the left breast before disappearing. Examination of the lungs throughout the fever and convalescence failed to reveal any abnormalities. He had commenced to expectorate dark blood-stained mucus in small amount, and definite ulceration of the soft palate with patchy white exudate was found. The patient felt certain that the sputum came from his throat and not from the

Case 1.



chest. In fact he stated that he hardly dared to cough owing to the bursting feeling produced in his head. By September 26 the sputum had become mucoid without a trace of blood, and simultaneously his soft palate was found to be clean though still injected.

On September 30 his tongue was noted to be clean and bright red, a sudden and marked contrast. From this day onwards the temperature gradually declined by lysis and coincidently there was great amelioration of the patient's symptoms, until by October 4 he complained only of weakness.

No rash was observed at any time nor was the spleen ever palpable or tender. Constipation and sleeplessness were present and marked throughout the height

of the illness. The patient lost two stone two pounds in weight and convalescence was slow but complete.

Maximum agglutination of OXK = 1:275 on September 28 (sixteenth day of illness).

When convalescent, the patient wrote the following account of the onset of his illness :—

"I first became aware of my illness while I was in the bazaar at Solon on Friday Sept 13th. I was overcome with a slight nausea, accompanied by weakness in my legs. I returned to my barrack room and went to bed feeling very tired, but I could not sleep. I tried to smoke a cigarette but the smoke seemed very harsh and burned my throat. I then tasted my cup of tea, but could not consume it owing to an unusual bitter taste that it left on my palate. At approximately 11 p.m. on the 13th I experienced an attack of shivering which lasted for about ten minutes, after which I noticed the first signs of a headache; very slight at first and later during the night becoming more severe. The pain then concentrated around and behind my eyes. On the 14th of Sept I felt very much the same with the addition of biliousness. I went to bed quite early that day. During the afternoon my headache became more severe, the pain being from my brow right over my head and across my shoulders. I had to keep my eyes transfixed, the pain being so severe if I turned my eyes to right or left, or to look up or down. Any bright light seemed to hurt my eyes. On Sept 15th I obtained some A.P.C. powders from the medical inspection room to try to relieve my headache and spent most of the day in bed. I reported sick and was admitted to hospital on Sept 16th. Between the 13th and 21st of Sept. I experienced numerous attacks of shivering followed by sweating."

Case 2.—Pte. L., aged 25, 1st Dorset Regiment, arrived at Solon from Sialkot in July, 1935. There had been no admission to hospital during his two and a quarter year's service in India.

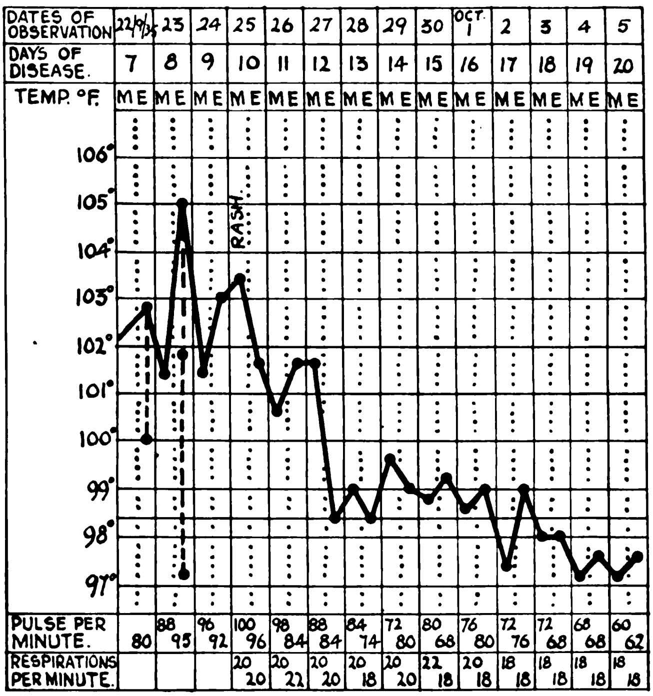
The patient was detained in the British Military Hospital at Solon on September 22. He complained of severe headache mainly behind the eyes, giddiness and occasional shivering attacks. Until he was transferred to Kasauli on September 24, these complaints continued and the temperature reached 105° F. on the evening of September 23. Differential white count on September 24 showed: polymorphonuclears 60 per cent, lymphocytes 35 per cent and mononuclears 5 per cent.

On September 25 (tenth day of illness) examination showed a young man with slight conjunctival injection lying quietly on his back. He was mentally lucid and complained of headache, pain on movement of the eyes, pain in the back of the neck and especially a constant aching pain across his shoulders. He was disinclined to move his head or eyes and was intolerant of noise. His tongue was thickly coated on the dorsum. The spleen was just palpable, soft and slightly tender. A rash, amounting to little more than an irregular flush, was present on the sides of the thorax and upper abdomen. It faded on pressure and left the imprint of the hand very distinctly. There were no macules, papules or petechiæ. This rash lasted only one day. Total white cell count was 5,200 per cubic millimetre and nothing abnormal was found on examination of the urine.

By September 28 the spleen was no longer palpable. The temperature had fallen to normal by rapid lysis on the preceding day and the patient was now free from headache, sitting up in bed and clamouring for solid food. Following the clinical termination of the disease on September 27 (twelfth day) there occurred an apparently secondary rise of temperature to a maximum of 99·6° F. and lasting five days. Convalescence was rapid, complete and accompanied by a prodigious appetite.

The maximum agglutination of OXK = 1 : 50 on October 7, 1935.

CASE 2.



Case 3.—Pte. G., aged 23, 2nd Border Regiment, arrived at Dagshai from Ferozepore on July 26, 1935. Previous history: Sandfly fever in June, 1934, is the only illness of note.

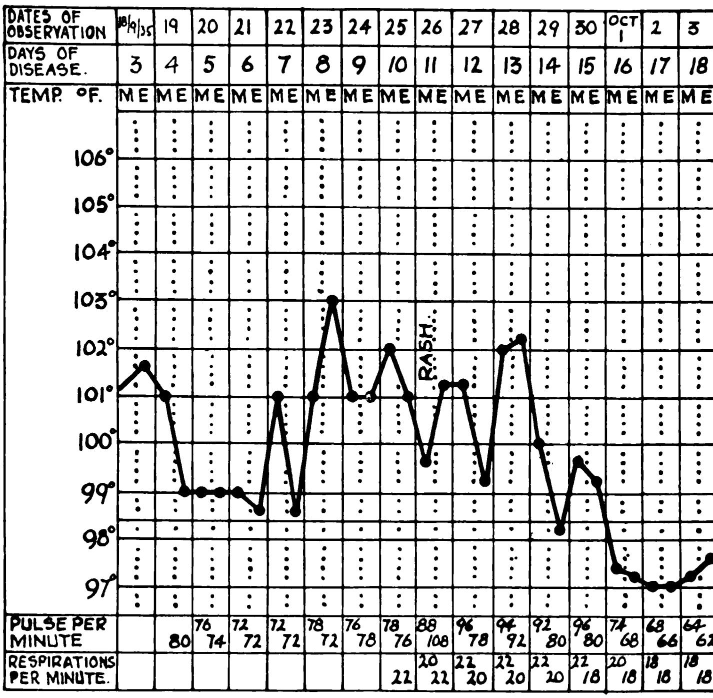
When detained in British Military Hospital, Dagshai, on September 18, at 9.30 p.m. he complained of headache, shivers and pain in the limbs. Next morning his temperature was 101° F., his face was flushed, the conjunctivæ were suffused and he presented a rather toxic appearance. The tongue was thickly coated and he was slightly constipated.

For the next two days the fever continued at a lower level, but the patient still complained of headache and shivering attacks. Thereafter the temperature rose again and reached a maximum of 103° F. on September 23. On September 24 the total white cell count was 6,875 per cubic millimetre and differential count showed polymorphs 65 per cent, lymphocytes 29 per cent, mononuclears 4 per

cent, and eosinophils 2 per cent. Prior to the patient's transfer to Kasauli on September 25 albumin was noted in the urine, although on the previous day there had been none.

On the morning of September 26, the estimated eleventh day of illness, examination showed the patient lying on his side with knees drawn up and his back to the window. His face was very flushed, the conjunctivæ were suffused and though lethargic he was perfectly lucid. He complained of severe photophobia and headache, repeated shivers, pain in the back and legs, slight pain on movement of the eyes, slight restrained cough, thirst and no appetite. The

CASE 3.



tongue was coated on the dorsum with thick yellow-white fur and his throat was slightly congested. The spleen was not palpable. There was no stiffness of the neck, Kernig's sign was absent and all reflexes appeared normal. Nothing abnormal was discovered on examination of the lungs and heart. The trunk and upper abdomen were the sites of an irregular blotchy, erythematous rash on which were superimposed a number of discreet round and oval, rose-coloured macules, which disappeared on pressure.

On September 29 (fourteenth day) the temperature fell by rapid lysis and coincidently the patient's headache and pains disappeared and he began to take more interest. Following this sudden fall the temperature again rose for one day and afterwards remained normal. The macules changed colour, first becoming dull pink and then copper, and were succeeded by faint brown staining

of the skin, of which no vestige remained on October 1. Remittent fever, repeated rigors and sweats, marked lethargy and lassitude, sleepnessness and a tendency to delirium towards the end of the illness were noticeable features of this case. Numerous blood films examined both at Dagshai and Kasauli failed to demonstrate malaria parasites. Convalescence was rapid and complete, the patient being discharged from hospital on October 21.

Maximum agglutination of OXK=1 : 200 on October 7, 1935.

The following account was written by the patient on recovery from his illness :—

"On Sept 16th I had a slight headache, but I did not think much of it. The same happened on the 17th. On the 18th the company went for a Khud run after breakfast, and when we got to the top of the Khud I felt very dizzy. My headache was much worse after dinner, so one of my pals gave me a aspirin tablet, and I got into bed. My pals also put a couple more blankets over me, and a couple of great coats. I was shivering and later sweated. I got up out of bed for my tea, and I felt alright afterwards. I went to a whist drive at night, and when it was nearly finished I started to shiver with cold just like I had got ague. [Note the double rigor.—F. K. B.] I went to my barrack room to get into bed, and the N.C.O. in charge of the room told me I would have to go sick. I told him I would be alright next day but he would not hear of it. So I got dressed and put my greatcoat on, and went up to the hospital at Dagshai. They took my temperature when I got there and it was 101·6°."

Case 4.—Bandsman J., aged 25, 1st Cheshire Regiment, arrived at Kasauli from Ambala on August 19, 1935. Within the past two years the only illness recorded was influenza in February, 1935.

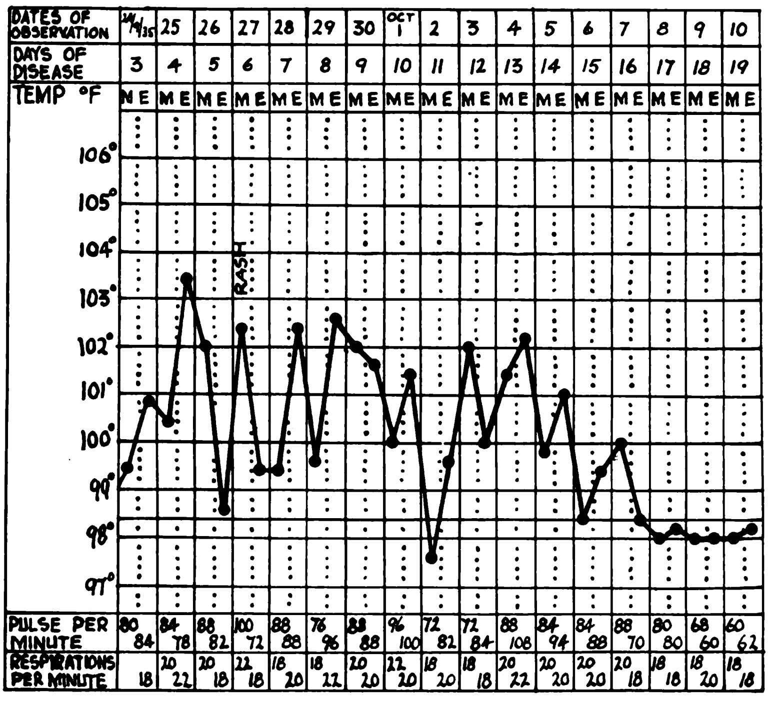
This patient reported sick at the medical inspection room on the morning of September 23. He complained of painful lumps in his groin and a small boil on his left leg. The Assistant Surgeon, who examined him, reported that the "boil" appeared to be an angry, red, tender pimple about one-third of an inch in diameter, with a small central yellow spot which had not yet burst. He could feel thickened tender lymphatics running along the anterior surface of the upper two thirds of the thigh to the enlarged tender inguinal glands in the left groin.

When examined by the writer on the morning of September 24 he was seen to be a sallow-complexioned thin man with slight conjunctival injection. He complained of feeling generally out of sorts, loss of appetite, repeated shivers and sweats, painful lumps in the left groin, and a small boil on the left leg. His tongue was coated with dirty white fur, the edges and tip being clean. There was slight congestion of the fauces and pharynx. Heart, lungs and abdomen were normal. On the middle third of the outer surface of the left leg was a small "boil" with necrotic ulcerated centre. Extending along the upper third of the inner anterior surface of the left thigh could be felt thickened tender lymphatics terminating in the vertical group of inguinal lymph-glands, which appeared as two swollen and tender lumps. Three days later the inguinal glands, though still swollen, were only very slightly tender, the boil had evacuated its slough, and thereafter it rapidly healed. It may be mentioned that the boil was energetically treated, at first with two-hourly magnesium sulphate foments and later with eusol dressings. Rigors, profuse sweats, lassitude and malaise continued.

On September 27 (sixth day) the patient complained for the first time of headache, chiefly behind the eyes, together with pain in the back. A rash was present on the sides and front of the lower chest, on the back, and upper abdomen. This consisted of a blotchy underlying erythema with scattered discrete rose-coloured macules. The rash faded on pressure. The patient now lay flat on his back with eyes closed, taking no interest in his surroundings, disinclined to move, but sensible when questioned. The throat was still slightly congested, but he had no cough. Sleeplessness, photophobia, repeated rigors and sweating were noted.

On September 29 the residual rash consisted only of scattered coppery macules, fading incompletely on pressure. Tenderness on pressure over the

CASE 4.



splenic area without palpable spleen was noted on this day, and persisted for forty-eight hours. Slight soreness of the throat, first noticed on September 26, continued until the 29th. Rigors, sweats necessitating frequent changes, headache and photophobia continued until October 6, when the temperature reached normal by lysis (seen best on four-hourly chart), and the patient looked and felt much more comfortable.

This fever, which lasted sixteen days, left the patient weakened but otherwise well, and convalescence proceeded sufficiently rapidly to allow his discharge from hospital fourteen days later. The possibility of the "boil" having been the portal of entry of the virus will be discussed later.

Maximum agglutination of OXK = 1 : 600 on October 7, 1935.

The patient's story was as follows:—

"This disease first affected me on Sunday Sept 22nd. I found a small what appeared to be a boil on the calf of my left leg which had caused two lumps to appear in my groin. Towards afternoon of the same date I felt a bit sickly and retired pretty early. Not feeling any better the following morning I reported sick. The Assistant Surgeon ordered hot foments for the boil. About 3 p.m. that day I had my first shivering attack and after that the shivers were repeated at intervals of about half an hour. I did not sleep that night. I felt cold and put extra blankets on my bed but kept waking up with shivering and sweating throughout the night. The following day my temperature had risen and I was detained in hospital. From the 24th onwards I felt more and more feverish, light headed and all the other symptoms attached to a disease. At night I found it very hard to sleep and had a terrible thirst, drinking several mugs of lime water. I suffered a lot with pains in the head, back and legs and I found it a very stiff job to move myself. The only temporary relief I could get for the above pains etc was an A.P.C. powder. On taking one and covering myself well up, after a good sweat I'd feel a new man for about two or three hours. After that the same old lethargy would set in. Food of any description held no interest for me, only fluids particularly lime water. On the 15th day the pains abated and my temperature is now normal and I feel more myself."

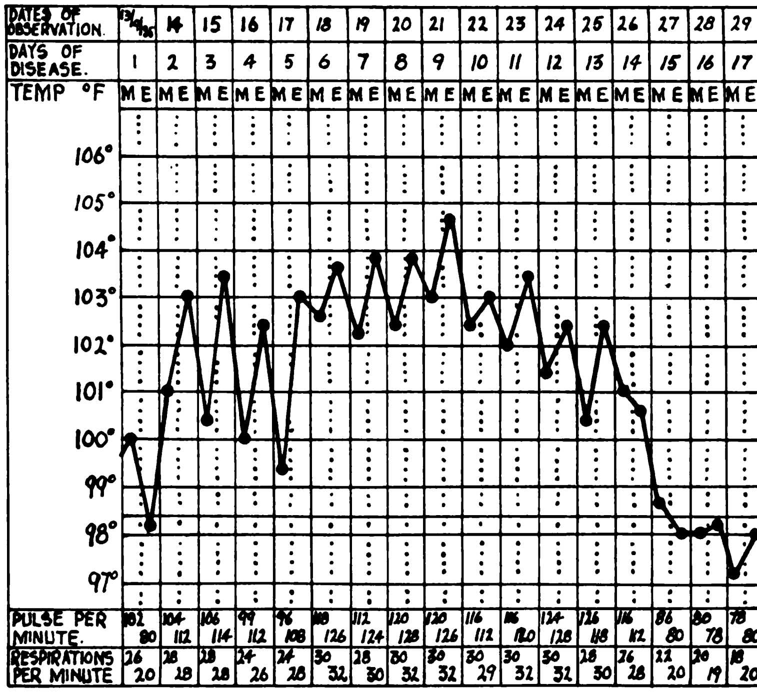
Case 5.—Enrolled follower, K. R. (cook), aged 30. This patient was admitted to the Cantonment General Hospital, Kasuali, on September 13, complaining of headache, malaise and shivers since early morning. His medical history sheet records no admission to hospital during his two years' service. He was seen by the Sub-Assistant Surgeon who diagnosed malaria clinically and began quinine treatment which was continued for three days without effect on the temperature. Beyond headache, mainly frontal and post orbital, together with rigors and impaired appetite, the patient had no complaints. His spleen was never palpable or tender and no rash was observed, perhaps due to his dark skin. The typical furred tongue, clean at the edges and tip, was present throughout. The temperature chart, the most typical of the present series, shows a gradual rise of temperature, at first markedly remittent, to a maximum of 104·6° F. on the ninth day of illness and termination by lysis on the fifteenth day. Constipation was noted but was not marked. There was no complaint of sore throat or cough—in fact the illness was remarkable for the absence of physical signs. He was discharged apparently quite well on October 8.

His maximum agglutination of OXK = 1 : 450 on September 27.

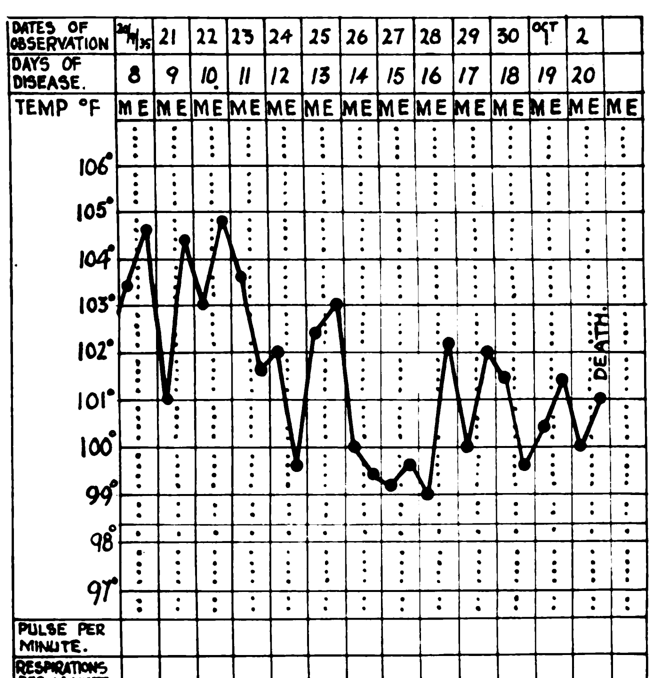
Case 6.—R. D., aged about 25. The patient was admitted to hospital (Cantonment General Hospital, Kasauli), on September 20, the estimated eighth day of his illness. He complained of headache, pain in the back and legs, shivers and loss of appetite. He was diagnosed malaria clinically by the Sub-Assistant Surgeon who ordered quinine.

When seen by the writer the next day he presented the appearance of typhus fever as seen in Kasauli, i.e. injected conjunctivæ, furred tongue, dorsal decubitus with eyes closed, congested throat and slight cough. On September 26 the

Case 5.


DATES OF OBSERVATION.
13/9/35 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
DAYS OF DISEASE.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
TEMP °F
M E
106° 105° 104° 103° 102° 101° 100° 99° 98° 97°
PULSE PER MINUTE.
102 80 104 112 106 114 99 112 96 108 126 112 124 120 128 120 126 116 112 124 128 126 118 116 112 86 80 80 78 78 80
RESPIRATIONS PER MINUTE
26 20 28 28 28 28 24 26 24 28 30 32 28 30 30 32 30 32 30 29 30 32 30 32 28 30 26 28 22 20 20 19 18 20

Case 6.


DATES OF OBSERVATION
20/9/35 21 22 23 24 25 26 27 28 29 30 OCT 1 2
DAYS OF DISEASE.
8 9 10 11 12 13 14 15 16 17 18 19 20
TEMP °F
M E
106° 105° 104° 103° 102° 101° 100° 99° 98° 97°
DEATH
PULSE PER MINUTE.
RESPIRATIONS PER MINUTE

temperature had fallen considerably and the patient appeared rather better. Next day, however, his cough was more pronounced, he was expectorating mucopurulent sputum and numerous rhonchi and râles could be heard over both lungs.

By September 28 patches of consolidation in both lungs were evident. On the following day the bronchopneumonia had extended and it now appeared that practically the whole of both lungs was affected. From now on the patient was desperately ill, delirious and markedly toxic and died at 9.30 p.m. on October 2. At no time was the spleen palpable and no rash was observed.

Maximum agglutination of OXK = 1 : 5,000 on September 23 (eleventh day).

Summary of the Chief Symptoms.

Headache is the predominant symptom. It may be the first complaint, almost invariably appears early in the disease and continues throughout the height of the fever. It was unanimously described by these patients as a constant severe dull ache, chiefly postorbital and to a less extent occipital. It is aggravated by any noise, and a heavy footstep or slamming door produces an almost unbearable throbbing, which continues for a few seconds after cessation of the noise. Coughing also increases the headache, the patient feeling that his head will burst open. For this reason such cough as exists is markedly restrained.

Pain on movement of the eyes and/or *photophobia* are present and appear to vary inversely in severity.

Pain in the back of the neck and across the shoulders is common and may be almost intolerable. Less often there is complaint of pain in the limbs and back.

Fever is of fifteen to twenty-one days' duration. It is remittent in type, especially so at the beginning and towards its termination, which is by lysis. A marked improvement in the patient's comfort occurs prior to the cessation of the fever, and coincides usually with a fall of temperature to normal by crisis or rapid lysis. Following profuse sweating, short intermissions may occur and are seen best on a four-hourly chart. Throughout, the pulse-temperature ratio is low, the pulse rarely rising to 100 per minute.

Posture of the Patient.—He either lies flat on his back with eyes closed or on the side with legs drawn up. Case 3, in whom photophobia was very marked, was not observed to open his eyes for two whole days! He lies absolutely motionless, takes no interest in his surroundings, is very disinclined to move his head, never complains unless questioned, and winces at sudden noise or if he coughs. When spoken to he answers questions lucidly. Though he may be acutely thirsty, he rarely takes the trouble to drink from his bedside cup.

Rigors, often double and repeated, are an early, marked and constant feature. Sweating is profuse and repeated to such an extent that the patient's clothing may need changing five or six times a day.

The rash is not striking. Noticed in three out of the six cases, it

TABLE II.—SEROLOGICAL RESULTS.

Case 1	Date	21.9.35	24.9.35	28.9.35	1.10.35	7.10.35	14.10.35	21.10.35	
	Day of disease	9*	12*	16*	19*	25	32	39	
	TH	200	800	1200	1200	1100	600	300	
	AH	120	160	300	350	200	150	110	T.A.B.
	BH	50	140	70	140	100	60	50	2
	TO	120	120	110	50	120	60	70	
	OX2	140	150	120	140	140	140	140	1.10.33
	OX19	225	250	175	120	140	175	200	10
	OXK	35	120	275	150	120	60	35	
	Wassermann ..	–	±	+	±	–	–		
	Blood culture..	Sterile	Sterile	Sterile	Sterile				
Case 2	Date	25.9.35	30.9.35	7.10.35	14.10.35	21.10.35			
	Day of disease	10*	15*	22	29	36			
	TH	0	30	35	0	0			
	AH	450	500	600	350	200			T.A.B.
	BH	2000	1400	2000	1400	600			2
	TO	0	0	0	0	0			
	OX2	0	0	0	0	0			22.2.34
	OX19	0	0	0	0	0			4.3.34
	OXK	0	30	50	35	0			
	Wassermann ..	–	–	–	–				
	Blood culture..	Sterile	Sterile						
Case 3	Date	23.9.35	24.9.35	26.9.35	30.9.35	7.10.25	14.10.35	21.10.35	
	Day of disease	8*	9*	11*	15*	22	29	36	
	TH	30	35	50	45	80	120	90	
	AH	0	0	35	50	45	60	0	T.A.B.
	BH	70	80	120	50	110	100	90	2
	TO	0	0	0	0	0	0	0	
	OX2	0	0	0	0	0	0	0	12.2.34
	OX19	0	0	0	0	0	0	0	21
	OXK	0	0	35	150	200	140	70	
	Wassermann ..				–	–			
	Blood culture..	Sterile	Sterile	Sterile	Sterile				
Case 4	Date	28.9.35	1.10.35	7.10.35	14.10.35	21.10.35			
	Day of disease	7*	10*	16*	23	30			
	TH	350	275	300	400	350			
	AH	550	500	550	600	600			T.A.B.
	BH	700	1600	1200	1600	1200			2
	TO	300	350	500	175	350			
	OX2	0	0	0	0	0			
	OX19	0	0	0	0	0			17.4.34
	OXK	30	30	600	600	350			27
	Wassermann ..	–	–	–	–				
	Blood culture..	Sterile	Sterile	Sterile					
Case 5	Date	21.9.35	27.9.35	3.10.35					
	Day of disease	9*	15*	21					
	TH	350	300	300					
	AH	140	120	110					T.A.B.
	BH	175	175	250					2
	TO	0	0	30					
	OX2	35	35	30					21.3.35
	OX19	35	45	30					31
	OXK	55	450	300					
	Wassermann ..	–	+						
	Blood culture..	Sterile	Sterile						
Case 6	Date	20.9.35	26.9.35						
	Day of disease	8*	14*						
	OX2	50	75						
	OX19	0	25						
	OXK	250	5000						

Key.—* indicates fever still present – = negative ; ± = negative incomplete ; + = positive.

appeared on the sixth, tenth and eleventh days respectively, some thirty-six to sixty hours after the temperature has reached its maximum. At first it is an irregular blotchy or mottled erythema with scanty superimposed round or oval rose-coloured macules, the whole fading on pressure. The erythema soon fades and the macules change colour to dull pink and then copper, at the same time fading less easily and less completely on pressure. A faint brown stain may persist for a day or so after the disappearance of the macules. In no instance was any trace of the rash visible at the termination of the fever. No papules or petechiæ were observed. Distribution—sides and front of the lower thorax and upper abdomen and back.

Sleeplessness is marked and often requires the exhibition of hypnotics.

Constipation, at times requiring relief by enemata, was noted.

The patient, even though he may have been a heavy smoker, does not attempt to smoke during the fever, because he says cigarettes "taste like burnt paper and make my head go round."

Serological Results.

The reader is referred to Table II (p. 169), in which are tabulated the results of the Weil-Felix, Widal and Wassermann reactions, together with the dates of last T.A.B. inoculations.

(1) The constant finding in this series of cases was the agglutination in varying degree of "O" suspensions of the "K" strain of *B. proteus* X.

(2) The maximum titres obtained varied between 1 : 50 and 1 : 5,000. The figure of 50 obtained in Case 2 is considered confirmation of the clinical diagnosis. It is worth nothing that this was the mildest case in the series.

(3) The late appearance of the maximum titre of "K" agglutinins corresponds with that observed by Anigstein (1933) in Malayan scrub typhus.

(4) In three cases (Cases 2, 3 and 4) there was at no time agglutination of OX2 and OX19. In the remaining three cases agglutinins for OX2 and OX19 were present. This was especially so in Case 1 where moderately high titres, which did not vary appreciably, were found. Presumably this patient possessed these agglutinins before the onset of this fever.

(5) As compared with the series of fifteen cases reported by Macnamara (1935) the titres now recorded are low; the average maximum in his series being 1 : 4,300 (highest 1 : 25,000 – lowest 1 : 125) and in the present series 1 : 1,094.

(6) The behaviour of the T.A.B. "H" and "O" inoculation agglutinins is worthy of note, e.g. TH in Case 1 and TO in Case 4.

(7) Attention is drawn to the variations in the Wassermann reactions, particularly in Case 1.

OTHER CLINICAL FINDINGS.

(1) Blood cultures repeated in each case were invariably sterile.

(2) Urine examinations showed negative results except in Case 3 in which a transient albuminuria was noted on the tenth day.

(3) White cell counts indicated some degree of leucopenia with slight lymphocytosis.

(4) Blood smears were found negative in all except Case 1.

ANIMAL INOCULATION.

An inquiry into this fever is at present being conducted by Lieutenant-Colonel G. Covell, I.M.S., Director of the Pasteur Institute, Kasauli. I am indebted to him for the following information and also for carrying out the Weil-Felix reactions in Case 6 with suspensions supplied by the Enteric Laboratory, Kasauli. Defibrinated blood obtained from Cases 2 and 6 on the ninth and eighth days of illness respectively was injected intraperitoneally into guinea pigs. The animals reacted after some days with fever and loss of weight but in spite of repeated passaging scrotal reactions have not yet been obtained. The results, however, are as yet incomplete.

THE ? PRIMARY LESION IN CASE 4.

Adopting Felix's (1935) serological classification of the typhus group of fevers, it appears that typhus fever (vector unknown) of the Simla Hills should be included in the group embracing Japanese river fever (tsutsugamushi fever of Japan, Malaya and Dutch East Indies), Malay scrub typhus and scrub typhus of the East Indies.

Instances of primary lesions occurring in the typhus group of fevers are: (i) The eschar or primary ulcer which is constantly found in tsutsugamushi fever; (ii) the *tache noir* of Fievre Boutonneuse; (iii) the ulcer reported in four out of twelve cases of tropical typhus of the East Indies by Emanuels (1932); and (iv) the two cases of Indian (?) tick typhus (Megaw) in which local and painful skin reactions following the bites of insects (unknown) occurred prior to the onset of fever (Ghose, 1928).

On the other hand, no initial lesion corresponding to these is found in Malayan scrub typhus (Anigstein, 1933). In addition to the actual eschar or ulcer it appears that some degree of lymphangitis and regional lymphadenitis are necessary concomitants for the lesion to be regarded as primary, i.e. the portal of entry of the virus. In Case 4 of the present series there occurred a small boil whose characters have been described above. In addition, lymphangitis and lymphadenitis were present, and appeared immediately before the onset of a clinically and serologically proved case of typhus fever. The patient did not notice any insect bites preceding the appearance of the lesion, and his considered opinion regarding this was written as follows :—

"I did not notice any pimple on my leg until I saw the lumps in my groin. My attention was drawn to these on September 22nd because I felt a bit stiff on walking. I thought the lumps might have been caused by a rusty nail in my boot, and so I examined my feet. Finding nothing, I searched my leg closely and came upon the boil: Upon pressing it a pain shot up my leg to the lumps in the groin. All this happened on Sunday Sept., 22nd. Next day I reported sick."

In answer to the question, "Have you ever suffered from boils, and if so when?" he wrote: "Last summer (1934) at Kasauli I was afflicted with two boils, one on the cranium and the other behind the lobe of my right ear. I am of opinion that these were caused by partaking of too much fruit, mangoes etc."

Taking all these facts into consideration, it appears that this "boil" was, in fact, the primary lesion.

In conclusion, I take this opportunity to thank Lieutenant-Colonel R. F. Bridges, R.A.M.C., Officer-in-Charge Enteric Laboratory, Kasauli, for help in preparing these notes and for carrying out the laboratory investigations of the first five cases. My thanks are also due to Major H. J. Bensted, M.C., R.A.M.C., for the Wassermann results, and to Lieutenant-Colonel M. White, M.C., R.A.M.C., Commanding British Military Hospital, Kasauli, for permission to forward these notes for publication.

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EMBARKATION MEDICAL DUTIES.

By Major S. J. L. LINDEMAN, M.C.,
Royal Army Medical Corps.

Amongst the many and varied duties on which Officers of the Royal Army Medical Corps are liable to be employed are those of an Embarkation Medical Officer. An officer may get these duties thrust upon him at any time in addition to his ordinary work.

The chief of all Embarkation Medical Officers is the "E.M.O. Southampton" who has quite a large space allotted to him in A.M.S. Regulations. He is assisted by a regular staff and is moreover at a terminal port so that he can embark and disembark his ships at leisure. It is often far otherwise with the amateur "E.M.O." at some port abroad, he has merely one short paragraph in regulations on which to rely. His ships are frequently in transit or stop for only a short period. His staff is probably an inexperienced Corporal and he is largely left to work out his own salvation. These notes are, therefore, written to help medical officers suddenly confronted with these unaccustomed duties. The notes are actually written from the point of view of the Embarkation Medical Officer, Alexandria, but the routine will be more or less the same anywhere abroad.

The Embarkation Medical Officer should keep in touch with the Embarkation Commandant's Office and get to know all the staff. He should receive a copy of Command "Q" Troop Movement Order and Embarkation Staff Disembarkation Order published several days before the ship arrives. The Troop Movement Order shows the names of all officers, nursing sisters and numbers of other ranks arriving, and to what station and by what means they are to be sent; while the Disembarkation Order gives the local detailed arrangements. Similar orders are received with regard to embarkation. Some time during the day before the ship arrives a wireless message is received giving the hour of expected arrival and the number of patients for hospital. The Embarkation Commandant should inform the Embarkation Medical Officer about this wire but if no news is received by evening, inquiries should be made and the hospital informed how many patients to expect.

Ships usually, but not necessarily, enter the harbour at dawn and get alongside an hour or so later. The embarkation staff go off to the ship in a launch and get on board as soon as the "pratique" has been granted by the port doctor. The Embarkation Medical Officer should accompany the staff and should have arranged for his N.C.O. and ambulance to be on the quay by the time the ship is expected to berth. On arrival on board he will be besieged by the R.A.M.C. officers or nursing sisters who will expect to be told at once their destination and exactly how they are to get there,

as well as details about local conditions. He will be wise, therefore, to obtain as much information as possible on these points.

He should then find the Senior Medical Officer of the ship who has, as a rule, the next best cabin to the Officer Commanding Troops. From him he will ascertain the number of patients for hospital and discuss about taking them off; this can be done profitably over the breakfast kipper. As soon as the ship is alongside, he should get the patients away in the ambulance, and if there are any recent sick who have not been admitted to the ship's hospital they should be sent as direct admissions from the quayside.

The further procedure depends on what the ship is doing ; if she is just in transit and has called in to drop a few people before going on elsewhere she may not even come alongside at all and it is only necessary to wave a *bon voyage* as she moves off. If, however, they are disembarking everyone and embarking others, the Embarkation Medical Officer is in for a busy time, especially if there are invalids to be got on board. The Senior Medical Officer of the ship will be anxious to be relieved as soon as possible, so the dangerous drugs must be checked and taken over and a receipt given for them. They may conveniently be given to the purser to lock up in his safe till they can be handed over to the oncoming Senior Medical Officer. Next, the Embarkation Medical Officer should visit the ship's hospital and make certain that all the documents are ready in accordance with A.M.S. Regulations. Almost anything he likes can be demanded under this heading as Regulations say " such reports and returns as may be called for," but there are three important items which must be taken at any terminal port. These are, the Senior Medical Officer's Voyage Report, Army Forms I. 1220 (case cards of patients admitted to ship's hospital), and Army Form B. 182, a return of all cases of sickness which have occurred during the voyage. The last is the most important of all and failure to render it has, in the past, caused much consternation and voluminous correspondence.

If there is a permanent ship's medical staff, the medical equipment is in the charge of the Quartermaster Sergeant and ordinarily need not be checked. If there is no permanent staff, the equipment must be checked, taken over and locked up till it can be handed over to the oncoming people. If necessary, arrangements should be made to replenish expendable drugs and dressings from local hospitals, but ships are well supplied and demands are usually small. In the event of a freight ship not being used for further trooping and being returned to its owners, the medical equipment has to be removed and sent to the nearest medical stores. It should, however, be returned to the Embarkation Medical Officer, Southampton, at the first opportunity. Having secured all the reports and returns they should be put away in a separate file marked, " Disembarkation," and the Embarkation Medical Officer may now repair to lunch and a good Indian curry to fortify himself for the next and more strenuous phase of " Embarkation."

Invalids are divided into Class "A" and Class "B." Class "A" are those requiring hospital accommodation on the ship and are further subdivided into Class "A" ordinary, those to go into the ordinary ship's hospital accommodation; Class "A" TB., usually four berths on the upper deck specially reserved for "TB." cases and the only part of the ship in which they are allowed to travel; and Class "A" Mental in the special ward. Class "B" are invalids fit enough to live in the ordinary troopship accommodation of their class. A complete list of all invalids to be embarked should be received from the D.D.M.S. several days before embarkation and similar lists from the various stations should be sent with the patients. It is best to make out two duplicate lists the day before embarkation: (1) A complete nominal roll by classes and categories showing diseases of all invalids to be embarked. (2) A summary of numbers in each class and category. The Senior Medical Officer usually comes on board with the rest of the ship's staff for the homeward journey the afternoon before embarkation and these lists should be gone through with him and the ship's medical staff, so that there is a clear-cut plan of how they are to be got on board and exactly where they are going. At the same time the dangerous drugs and medical stores, if necessary, can be handed over to him.

For removing stretcher cases from a train and putting them on the ship it is essential to have trained stretcher squads detailed for that purpose. It is unsatisfactory to rely on drafts of the R.A.M.C., or others also embarking, as they are apt to be difficult to get hold of just when required and are generally fully occupied getting themselves and their kits aboard. Frequently trains arrive with invalids from different places at short intervals and it is a matter of some urgency to get the first train unloaded in time to make room for the next. The exact route by which stretcher cases will reach the hospital must be reconnoitred and explained to the stretcher squads. In some ships they are hoisted by derrick from the quayside and lowered direct to the hospital flat, in this case arrangements must be made with the ship's officer in charge of loading, usually the troops' officer, to have his crew and hoists ready at the proper time. In other ships stretcher cases are carried up the gangway and lowered down a stretcher lift from the upper deck to the hospital level. The lift should be tried before use as it is apt to stick. There will usually be some mental patients and arrangements must be made with Senior Medical Officer and Officer Commanding Troops for a guard to be put on them as soon as they get on board. Troopships have accommodation for six to eight mental patients and the guard consists of one non-commissioned officer and eight men; two men on duty at a time, one inside and one outside the room, doing two hours on and four hours off.

As regards "B" class invalids, the cabin numbers of all first, second and third class invalids should have been ascertained from the embarkation

clerk, who does the actual allotting of the berths. These numbers will be written down on the lists against their names and cabins located so that they can be led or directed straight to them on arrival.

If there are a number of troopdeck invalids belonging to one unit of which a draft of non-invalids are also going, it is advisable to let them all be put on one of their unit mess decks, but the Embarkation Medical Officer must know the number of the mess deck and where it is, so that he can hand them over to the Senior Medical Officer. When the troopdeck invalids are of many different units it is best to arrange with the berthing clerk to reserve one or more mess decks specially for them. The mess on the same deck and nearest to the hospital is usually chosen, and this should have been arranged as soon as the approximate numbers were known, otherwise the mess decks will have been already allotted and it will be difficult to alter them.

It is important that the kits of invalids should come with them and be kept separate and apart from the ordinary regimental kit. This is done because the kits have to be placed in the hospital store on the ship in order to be available to accompany the patients to Netley on arrival at Southampton. If kits are not sent and kept separate it will be found impossible to get hold of them on the quay; they will be loaded with ordinary regimental baggage and will cause delay and confusion at Southampton. A list of kits is also supposed to accompany the patients but is often forgotten; it is of special importance in the case of hospital or mental patients who may not be able to identify their own kits.

Frequently there will be alterations at the last moment, such as deletions, additions, while Naval or Royal Air Force patients have a habit of turning up unexpectedly to complicate things further. In addition to invalids a certain number of sick transfers are sure to arrive. These are people who were detailed to sail in the ship in any case. In the meantime they have been admitted to hospital but are considered fit to travel. When embarked they should be inspected to decide whether they are fit to live in the ordinary ship's accommodation of their class and perhaps attend for treatment, or whether they need admission to the ship's hospital. Some of them might even be stretcher cases. Having got all the invalids and sick transfers on board they should be handed over to the Senior Medical Officer of the ship, being checked off with the lists to see that all are present and correct. By this time the ship's hospital table will be piled high with medical and other documents, but the important thing is to make certain that the Senior Medical Officer knows what invalids he has got on board and any special points about treating or nursing them, and that the Embarkation Medical Officer has a complete nominal roll of all invalids actually embarked. Apart from the invalids it is advisable for the Embarkation Medical Officer to find out cabin numbers of any R.A.M.C. or nursing sisters or friends who may be sailing as they will certainly expect him to give them this information. The Embarkation Medical Officer has also to

attend the routine inspections with the Sea Transport Officer and the embarkation and ship's staff. The preliminary inspection is a thorough and deliberate one of the whole ship, usually done when the ship is empty the day before sailing and embarkation has started. The final inspection is immediately before sailing when the embarkation is complete; it is a hurried rush around and all personnel are seated at their mess decks; it is mainly to see that people are in their places and that there is no overcrowding. After each inspection board papers have to be completed. The board is presided over by the Sea Transport Officer and the proceedings are signed by a number of people. If any information is required as to the time of sailing or future movements of the ship, the Sea Transport Officer is the most reliable source from which to get it, as he controls the shipping.

Having completed all these duties satisfactorily the Embarkation Medical Officer will heave a sigh of relief as the band plays "Auld Lang Syne" and the ship slowly slips away from the quay. He should then write his report to the D.D.M.S., attaching the numerous reports, returns and certificates which he has collected.

Editorial.

REPORT OF THE MEDICAL RESEARCH COUNCIL.

THE Report of the Council for the year 1934-1935 contains much of interest not only to the specialist researcher but to the ordinary practitioner. In the space available we can only refer to certain subjects, but we hope that what we have written will induce our readers to make a more intimate acquaintance with the various researches carried out for the Council.

The story of the isolation of ergometrine by Dr. Dudley is of pathetic interest as he died in 1935, just when the report of his work was being published.

Earlier investigations on the preparations of ergot had shown the presence of a whole series of alkaloids, each with its particular pharmacological properties. Ergotoxine, discovered in 1906 by Barger and Carr, was considered responsible for the characteristic activity of ergot preparations as it had a strong stimulant action on the uterus. It is readily converted into ergotinine, discovered in 1875 by Tauret, which is quite inactive.

In the succeeding twenty-seven years other alkaloids were obtained from ergot chemically distinguishable from ergotoxine, but almost identical in pharmacological action. Ergotamine, the best known of these, was discovered by Stoll in 1920; this also has an inactive isomer ergotaminine.

It had never been completely accepted that ergotoxine or any of the other alkaloids would account for the activity of many ergot preparations successfully used in medical practice. The watery extracts figuring in many pharmacopœias were found to be free from ergotoxine and the other alkaloids; moreover these substances did not produce their effects readily when given by the mouth, so that even if they had been present these alkaloids could hardly have come into action under the usual conditions of practical therapeutics.

The disparity between pharmacological evidence and clinical practice remained unexplained until 1932 when Chassar Moir, using a method for obtaining a quantitative record of the contractions of the human uterus in the puerperium, showed that a watery extract of ergot administered in ordinary doses by the mouth evoked vigorous contractions of a uterus which had previously been quiescent. This stimulant effect, lasting some hours, was not produced by any of the known constituents of ergot administered in a similar manner.

An investigation was then begun in which Dr. Dudley's fractionation of ergot extract was checked at every stage by Dr. Moir's clinical tests; and in March, 1935, they were able to announce the isolation of ergometrine as

the substance responsible for the familiar actions of ergot. The effect of ergometrine, unlike that of the other alkaloids, is evanescent; it has disappeared by the following day and even with the repeated administration of large doses it does not cause the gangrene which the other alkaloids produce. The characteristic effect of ergometrine is stimulation of the uterus especially in the puerperal condition, and it gives in uncomplicated form the action of ergot required in obstetrics and gynæcology.

In the report for 1927-28, mention was made of watery extracts of the liver that could be injected into patients suffering from pernicious anæmia. Preparations of this nature came into general use when it was found that one injection exerted its action over several days and was equivalent to half a pound of liver by the mouth daily.

A further development has been made by Dr. Dakin and Dr. West, who have prepared the active hæmopoietic agent from liver in a much purer form than has hitherto been possible. This substance is not a simple chemical body.

At the invitation of the Council, three investigators have tested the substance prepared in England under the supervision of Dr. Dakin on cases of pernicious anæmia. Injections of 0·1 to 0·2 gramme of the active preparation, once weekly, brought about a large increase of the red blood-corpuscles of the patients and in a few weeks restored them to health.

In the near future, improvements in technical procedure and further purification of the substance will probably be made. At present it is impossible to tell whether any particular preparation will be active until it has been tested on cases of pernicious anæmia. No laboratory test of activity has yet been established; and the chemical complexity of the substance has prevented the discovery of any chemical or physical property which can be regarded as a measure of its therapeutic influence.

Since 1930 the Council have assisted in the establishment of a research unit on puerperal sepsis at the Queen Charlotte's Hospital in the Bernhard Baron Research Laboratories attached to the new Isolation Block at Hammersmith. It has long been known that the agent responsible for puerperal sepsis is a streptococcus which hæmolyses red blood-corpuscles. Employing a technique developed at the Rockefeller Institute, New York, the workers at Queen Charlotte's Hospital have been able to show that the hæmolytic streptococci normally present in the genital tract of healthy parturient women are not identical with those causing puerperal fever and are usually harmless to the human hosts. The infecting streptococcus must therefore have been introduced from outside sources. Dr. Colebrook has shown the multiplicity of these sources. She has proved that the streptococci of the respiratory tract bear an intimate relation to puerperal fever. The respiratory tract of the mother must also be taken into account as well as that of her attendants, and familial sources of infection have been incriminated in not a few instances.

It is obviously undesirable for any person suffering from an acute affection of the respiratory tract to engage in maternity work. Small hospitals and nursing homes should not undertake maternity and surgical cases unless the nursing staffs can be kept separate. A wider employment of laboratory services is to be desired.

For many years the Council have provided a substantial part of the financial support of the Strangeways Research Laboratories at Cambridge. Workers there are engaged in the study of fragments of living tissue in artificial culture.

Of particular interest are the experiments on the "organizer" in early embryonic development. Spemann has shown that when certain structures found in the embryonic tissues of amphibians are introduced into abnormal situations in another egg, they induce the surrounding tissues to produce a second, or part of a second, embryo. This has been proved to be true of warm-blooded vertebrates in the Strangeways Laboratories in cultures of the germinal area of the fowl. Further work has shown that this organizer substance is probably related to the œstrogenic compounds and that these will act as inducing agents when introduced into the early embryo.

An important part of the work has been the effect of gamma- and X-rays on tissue culture. The first effect is an alteration of the rate of cell division in exposed tissue; by increasing the dose cell migration is hindered, but only with relatively enormous doses can a lethal effect be obtained. Using fowl embryos it has been possible to study the effects of irradiation on the same tissues in the presence and in the absence of a circulation. The results show that so long as the circulation remains intact, it favours the recovery of the cell processes, such as cell division, which are first affected. If the dose is raised so as to destroy the circulation the degenerative effects are enhanced by the generalized destruction which normally follows interference with the blood supply.

For some time past the Council have been interested in the standardization of sex hormones, so that the practitioner might have a substance active to a definite degree. During the past year a conference convened by the Permanent Standards Committee of the Health Section of the League of Nations met in London, under the Chairmanship of Sir Henry Dale, to consider the possibility of extending the principle of standardization to sex hormones. As a result, a uniform scientific nomenclature and standard units have been adopted for three important substances. These are, firstly, "œstrone," "œstriol" and "œstradiol," the œstrus-producing hormones; secondly, "progesterone," the hormone of the corpus luteum; and thirdly, "androsterone," a substance closely related to that responsible for the development of the secondary sex characteristics in the male.

Dr. Parkes and his co-workers have been studying the occurrence of male and female hormones. Although the male hormone and the secondary characters produced by its action are in the main characteristic of the

male, as those produced by œstrone are characteristic of the female, this distinction does not strictly hold in either case. Evidence is accumulating that the sex distinction is due rather to a preponderance than to an exclusive production of male or female hormones as the case may be.

The view that the testis produces both male and œstrogenic hormones, of which the former may lose its preponderance as maturity gives place to senescence, may have an important bearing on the degenerative enlargement of the prostate in man. If the enlargement of the prostate in man is partly due to the glandular hypertrophy of the uterus masculinus embedded in the middle lobe, it is considered reasonable to assume that this condition is associated with a growing predominance of an œstrogenic hormone from the senescent testes. It has been shown that the effect of œstrone on the uterus masculinus of the male rhesus monkey can be opposed by simultaneous administration of a male hormone.

Further work on the virus of influenza has been carried out in relation to its transmission to ferrets and mice. The possibility of obtaining from human cases of epidemic influenza a virus infecting a ferret and transmissible then to other ferrets and to mice has been confirmed by Dr. Francis in the Rockefeller Institute with material obtained from an epidemic of influenza at Porto Rico, and from Philadelphia and Alaska, where local outbreaks occurred. Up to the present it has not been possible to inoculate mice directly with the virus from human cases; yet every strain of the virus which has passed by primary inoculation through the ferret has been found to be then infective to mice. This fact has been of great value in the titration of immune sera.

A certain method of giving ferrets and mice complete immunity to experimental infection has not yet been found.

A subcutaneous injection of virus, which is not infective when so given, or a formalized vaccine of the virus, appears to give the ferret protection against the involvement of the lung in a subsequent infection, and antibodies appear in its blood; it also reinforces immunity in ferrets previously infected. In the mouse, injection of the virus appears to give complete protection against the infection itself in a certain proportion of cases.

The serum of a horse, immunized against the virus, has been concentrated by separating the effective fraction of the immune serum, and injections of this stronger preparation into mice have given results which suggest that such a serum might be of value in the treatment of influenzal pneumonia.

Cultivation of the virus on the chorio-allantoic membrane of the developing chicken has given evidence of multiplication under these conditions, as demonstrated by increase of infective action on ferrets and mice. Even more successful has been the cultivation of the virus in a saline medium containing fragments of surviving tissue from a chicken

embryo. Dr. Francis and his co-workers have made experiments which provide convincing evidence of the multiplication of the virus in a medium containing embryonic chicken tissue.

In last year's report reference was made to the immunizing properties of preparations of different neurotropic viruses inactivated by the action of light in the presence of dyes, such as methylene blue and acriflavine. It was stated that rabbits could be given a substantial degree of immunity against the "fixed" virus of rabies by previous inoculation with the photodynamically inactivated virus. It has now been found that such inoculation protects them also against the "street" virus, obtained direct from a rabid dog.

A most surprising discovery is the ease with which certain bacterial spores are killed by the photodynamic action. Even anthrax spores, normally highly resistant to heat and chemical disinfectants, are killed by exposure for one hour to light from a 300 candle power Osram lamp, at a distance of 13 centimetres in the presence of a 1 : 50,000 solution of methylene blue.

In previous reports reference was made to the measurement of virus units by the technique of ultrafiltration through graded membranes devised by Dr. Elford. The size of the particles was calculated from the average diameter of the pores which just retained them. Further experimental verification of this procedure has now been made on two large-moleculed proteins—hæmocyanin and edestin. The results of filtration determinations gave hæmocyanin a mean diameter of 23 millimicrons, and edestin a mean of 7·5. The results recorded by Svedberg with his method of ultracentrifugation were for hæmocyanin 24 and for edestin 8 millimicrons. These determinations give added confidence to the measurements of virus units of a similar order of magnitude.

Dr. Elford has devised for use with an ordinary centrifuge capable of 15,000 revolutions a minute a new type of inverted fluid container which enables the rate at which a fluid is freed from infective particles to be determined, without danger of re-suspension during deceleration of the motor. Determinations of the size of the particles of hæmocyanin by this method show good correspondence with those obtained by filtration. Determinations by both methods of the size of the units of the influenza virus are in progress.

Mr. Bruce White has made further study of the vibrios of cholera and related vibrios. He has confirmed the findings of Japanese workers as to the existence of subtypes of the cholera vibrio itself. By the use of special methods he has been able to isolate rough (R) variants and has found that all the (R) forms of the true *V. choleræ* are identical whatever serological differences they had shown in the smooth (S) condition. He has also found degraded forms of vibrio, similar to those which he

obtained in his study of the Salmonellas and termed the "ρ form." In the case of the vibrios of degraded type an agglutinating serum prepared from the ρ form of any vibrio reacts with the ρ forms from all others.

Apart from these degraded variants, no evidence has been obtained of change of any vibrio into one of a different serological type, whether as the result of animal passage, of treatment with bacteriophages, or with immune sera. The vibrios from El Tor, generally supposed to be non-pathogenic, are serologically indistinguishable from the true *V. choleræ*, and can only be differentiated by their power of causing hæmolysis of the red corpuscles of sheep's blood. Dr. Vassiliadis, of the Egyptian Quarantine Service, and Mr. Bruce White, have shown that when a potent true *V. choleræ* has been exposed to the action of a potent bacteriophage, the survivors are found on further cultivation to have acquired some degree of this hæmolytic action.

The first international standard for insulin, adopted in 1925, was prepared in a dry, stable condition by the late Dr. H. W. Dudley. At the time of its preparation and of the definition of the unit as "the specific gravity contained in one-eighth part of a milligramme" of this first standard, it represented the best preparation of insulin then obtainable. Insulin as now manufactured often contains twenty units per milligramme, and some manufacturers convert their whole output into pure crystalline form. The original standard accordingly had to be replaced by one more comparable to modern pure insulin. The preparation of this material was undertaken by Dr. D. A. Scott, of Toronto, who, during his work, found that the crystalline insulin consists of a zinc salt of the true hormone. Eventually, rather more than fifty grammes of the pure recrystallized insulin was prepared in Toronto and sent to the National Institute at Hampstead, where it was distributed in suitable small quantities into some thousands of glass tubes, which, after complete desiccation of their contents, were filled with pure dry nitrogen and hermetically sealed.

The unit value of the new standard had to be determined in terms of the old. An International Committee has decided that the proper value to be assigned to the new standard is twenty-two units per milligramme.

This decision has been accepted by the Permanent Commission on Biological Standards, and the unit is thus defined, for all the world, in the terms of the new standard.

Clinical and other Notes.

DRAINAGE AND THE GROWING OF GRASS.

By Major A. E. CAMPBELL,
Royal Army Medical Corps.

Work for some years as an anti-malaria officer had shaken one's belief in the efficacy of open masonry drains laid in the bottom of water courses of varying depth.

Being used by Nature as storm water channels, by the engineer for disposal of sullage water from nearby built up areas, and by the local inhabitant for sanitary and insanitary purposes, such water courses gain an added notoriety in being beloved by those in search of mosquito breeding, who name and malign them for posterity in annual and other reports.

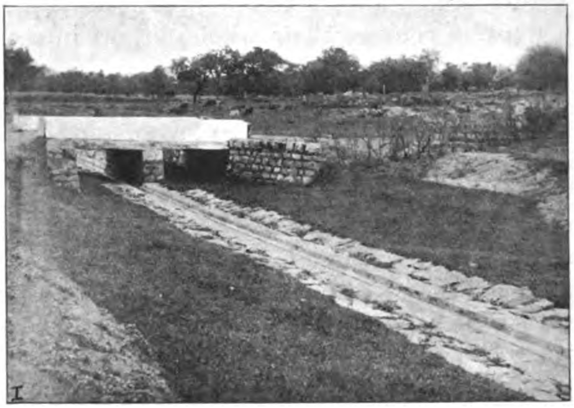

Fig. 1.—(1) The wing walls of the abutments of the bridge showing the line of the original banks, now protected from further erosion. (2) The grass growing beneath the bridge.

In 1930 an experiment was carried out at Rawalpindi in the construction of a length of drain laid at the bottom of the nullah and of such size as to take the normal flow of water. From the edges of the drain firm earth packing was laid in a gentle slope up the highest flood level, and on this grass was planted. The small masonry drain carried the normal flow in a confined space and at a steady rate, while the banks when consolidated stood up to sudden flooding occurring for a short time after rain.

It was learnt in this preliminary construction that there must be no obstruction even of small size in the nullah bed or any sudden change of level. Such change or obstruction inevitably resulted in a disturbance of the flow of water and subsequent erosion even of firm sod.

In 1935 it was noticed that grass could be made to grow easily in Secunderabad and it became possible to suggest a similar work there on a length of drain which was being laid in a shallow nullah normally existing as a series of pools connected by a slowly moving stream and forming ideal mosquito breeding places. Part of the construction, carried out under the direction of the Cantonment Engineer (Mr. V. G. Panwalker, B.E.,

FIG. 2.—Old retaining walls preventing erosion of the banks but not silting up.

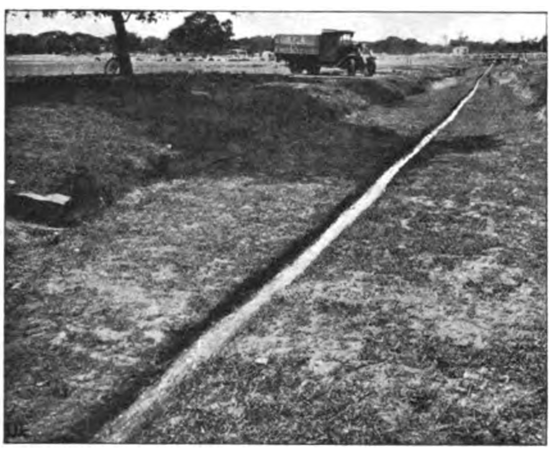

FIG. 3.—Banks and bed protected by grass.

A.M.I.E.), is illustrated in fig. 1 which shows the central drain of half-round Hume pipe laid in stonework and the extent of the grass planted. The photograph was taken when twenty inches of rain had fallen after completion of the work.

While this construction was in progress, an enthusiastic sanitary inspector was given a gang of six coolies and told to carry out similar work in a tributary of the same nullah, but only down to a "kutcha" central

drain, as no funds were available for masonry or concrete channels. Of three hundred yards length so treated and finished just before the onset of the rains all but about thirty yards of the upper and last portion completed stood the strain admirably and has remained firm ever since.

This effort was followed by a similar one on the part of a different inspector using a new gang of coolies. The drain before and after treatment is shown in figs. 2 and 3.

A problem of a somewhat different nature was presented by a disused irrigation reservoir or "tank" which, although not holding water to any considerable depth, received and retained sufficient water to form innumerable pools, one of which is illustrated in fig. 4.

FIG. 4.—A true photograph given unnecessary bias by an over-zealous photographer who limited its background.

The area after work had been carried out is shown in fig 5.

Since the completion of the drains already referred to a number of others have been treated with what are believed to be successful results.

The actual planting of grass presented no special difficulty as sods were available locally. Once the bed was prepared, the sods were laid, pounded well down, and kept watered until a good growth of grass had occurred.

In one place sods were not placed over the whole area to be covered but were distributed in the manner of Reverdin's skin grafts. Results were as satisfactory but slower.

It is not suggested that the idea or methods employed are original. It is known that similar work has, and is, being carried on in other stations in India and the foregoing account may only serve to stress the possible use of grass to assist in the maintenance of drainage and its application in an economical manner with unskilled labour and little technical assistance.

Apology may be due for an attempt to stray into the sphere of the engineer, but he has already disclaimed any interest in what he referred

to as horticulture and so the experiences are put forward for what they are worth.

The fact that it was possible to remove a series of mosquito breeding places such as are shown in fig. 2 without the laying of masonry drains suggests a temporary measure which may be applied prior to the laying

FIG 5.—The foreground corresponds to the area shown in fig. 4.

of such drains and even a more permanent measure where there is a small intermittent normal flow of water. In either case it has been proved that no harm is done and both possibilities are now being tested locally.

Acknowledgment is due to the Cantonment Engineer and the staff of the Sanitary branch of the Health Department of the Secunderabad Cantonment Authority for the execution of the work, and to Brigadier H. St. G. S. Scott, C.B., D.S.O., President, Secunderabad Cantonment Board, and to Colonel H. L. Howell, O.B.E., M.C., Health Officer, Secunderabad, for permission to forward these notes for publication.

CORONARY THROMBOSIS: A PERSONAL EXPERIENCE.

BY "X."

AN article in the June number of the Journal on the "Examination of Elderly Men for Fitness for an Active Physical Life" devotes some space to the subject of coronary occlusion, and as this threat to the senior ranks seems to be increasing in frequency it is thought that an account of a personal experience may be of interest.

The patient was described in his medical history (written by a young house surgeon) as a "well-preserved" man of 52. Family history good. Previous medical history unimportant with the exception of a certain amount of malaria, and a chronic amœbic dysentery, which had never given much trouble, and had finally been cured about eighteen years previously. After an active life he had settled down to more or less sedentary work. He had for years been a moderate pipe smoker.

The weather was hot and he had been very busy. For some days he had noticed a slight ache in his antecubital fossæ, particularly the left. On June 8 this was marked in the evening when he knocked off work, and was unusual enough to make him wonder vaguely whether it was really "rheumatic" after all. The possibility of a cardiac origin crossed his mind, but was dismissed as absurd. The pain disappeared after a short rest and was forgotten until next day.

On June 9 it was very hot, and after a busy morning he had lunch at 1 p.m. and afterwards sat down to smoke a pipe. He was feeling tired and the pain in his antecubital fossæ had returned. Unaccountably restless and ill at ease he left his office and going to the laboratory took 5 grains of aspirin which he thought might help. Ten minutes later his restlessness had increased and had become a definite feeling of apprehension. He took his own pulse and found it so slow—under 30—that he thought he must have counted wrong.

Just at this moment one of the surgeons came in and seeing the patient's state made him lie down on a couch while he went off to get help. After lying flat for a moment the patient felt that he simply must get up, so he rose and staggered into the hall, where he would have fallen but for the arrival of assistance. He was carried back to the couch in a state of collapse, but did not lose consciousness completely.

The notes of the case state that the patient had severe oppression and grasping pain in the sternal region, but the subject of the notes has no recollection of any very severe pain, and certainly had no sense of impending dissolution.

He was put to bed at 2.45 p.m., pulse 48, and heart sounds very subdued in quality. Systolic blood-pressure recorded as 75.

By 6 p.m. under appropriate treatment the pulse had risen to 57 and the blood-pressure to 118/90.

At 5 p.m. the patient vomited, and thereafter nausea and vomiting were a distressing feature for the first forty-eight hours. Glucose intravenously brought relief, and the nausea did not recur.

On June 10 a tendency to Cheyne-Stokes' respiration was noticed by the patient himself, and confirmed by the attending physician, who also found distinct pericardial friction. Leucocyte count on this day was found to be 21,600 with 91 per cent polymorphonuclears. The temperature was 100·6° F. It was remarked that the patient's colour was very bad, that pain in the arms was distressing, and that tightness in the chest was

complained of. This was relieved by intermittent administration of oxygen.

The temperature remained slightly raised for several days and the evening reading did not return to normal until June 18. Definite auricular fibrillation occurred several times during the first week, the pulse reaching 110 on June 13, and there was a fairly constant reduplication of the second sound.

By June 19 the patient was definitely convalescent, the leucocyte count had fallen to 9,200, and he was discharged from hospital and sent home by ambulance on June 29.

For the first three weeks of this illness the patient was given absolute rest, with special nursing care night and day. After about a month he was allowed to sit up, and was walking in six weeks. He returned to work on September 1, but took things easily for a good long time. Extrasystoles were rather annoying at first but cleared up rapidly under treatment.

The very enlightened medical care and excellent nursing which were available probably carried the patient through what seems to have been a moderately severe attack. Giving up smoking was a hardship, and he still misses it after three years' abstinence. He still takes it easy but this is from inclination rather than from necessity.

The importance of early recognition of the underlying cause in an attack of coronary occlusion is obvious, for if the devitalized area is subjected to strain before repair is complete there will be danger of rupture, or at least bulging of the heart wall. If the heart can be tided over the first shock and given as little work as possible to do until the scar is firmly organized it would seem that recovery is assured provided the area of cardiac wall involved is not too extensive.

Travel.

TWO MONTHS' LEAVE.[1]

By Major M. B. KING, M.C.
Royal Army Medical Corps.

It was an article in the *Field* that convinced me that a small shoot in Africa need not be much more expensive than two months in Kashmir. Agents' advertisements, however, were definitely not encouraging, and I had almost abandoned the idea when a friend said: "Why make any bandobust with an agent? Why not just blow in? You'll have a holiday in a jolly country anyway." I owe that friend a lot.

It was, however, without much confidence in the outcome that I sailed from Bombay in the "Ellora" on July 10, 1935, bound for Mombasa

[1] Published by permission of the *Hoghunters Journal.*

in the teeth of the south-west Monsoon. The less said of the subsequent week the better. But on the morning of the 17th we anchored in the roadstead off Mahé. the chief island of Seychelles, and our troubles were behind us. Mahé, at any rate in July, is a little bit of Heaven inhabited by the progeny of French corsairs and African slaves, a pleasant, placid race, French speaking and very civil. The island is mountainous and coconut palms grow thickly from the precipitous rocky hills down to the water's edge, while the coast is indented by little bays of the clearest green water, and occasional lagoons are formed by a reef to seaward. The bread-fruit tree may be picked for the asking. Every day is, I understand, Sunday. To-morrow never comes. Living is cheap in Mahé, hotels charging 5 rupees a day, and the sailing and sea-fishing should be excellent in the earlier months of the year. An ideal sport for a quiet month's leave. I left with regret. Mahé is a holiday resort for Kenya dwellers who find an annual return to sea level beneficial after a prolonged sojourn at

The beach—Mombasa.

A Seychelles lagoon.

7,000 feet; and it was my very good luck that some of them were returning to Africa in the "Ellora."

A letter of introduction to a knowledgeable man in Nairobi was one result.

Mombasa on the 20th impressed me with its cleanliness, its perfect weather, the number of shillings to be had for my rupees and the number of things a shilling would buy. I should have liked to stay longer but felt that pleasure might be postponed until after my trip up-country. The train journey to Nairobi was pleasant enough. Production of my leave certificate secured me a half-fare concession, the accommodation, though cramped if judged by Indian standards, was comfortable and the dining car provided good meals. Many of the best people travel second class and use the first dining car. Five minutes after arrival in Nairobi I had begun to learn something of the African character. I gave a newsboy 1/- for a tuppenny paper and he went for change. He has not yet returned. But that was the only unpleasant happening during the three days I spent there. I presented my letter of introduction, got some good advice and was handed on to even more knowledgeable people, all of which resulted in

my leaving on the 24th in a hired box Ford for my base 130 miles farther on. Here I found a really good hotel and some quite pleasant trout fishing, so it was no penance to wait two days while a local business man (and ex-Army officer) fixed up my safari. Acting on his advice I motored a further fifty miles and prepared to pitch my camp. Here the angels intervened in the shape of two officers of the King's African Rifles who persuaded me, with no difficulty, to pitch my tent with them.

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"Shoot that one," said Hoot. I stepped from the car and did as I was told. The zebra dropped. We dragged it up to a bush, left it as ground bait for lions and drove on. Our path—a neglected track—ran through a vast, yellow, grassy plain dotted with thorn bushes and flat-topped acacia

A little preliminary practice.

trees. The zebra herd had halted from their panic and away beyond them a family of oryx was grazing untroubled. The inevitable Grant's gazelles watched us without alarm some distance to the right.

It was seven o'clock in the morning and the air was like wine. But we were bound for a spot some miles on where there was news of lion and the claims of lesser game were postponed. Two spindly gerenuk ran across the track, and then right in front we saw the lovely black and golden neck of a large male giraffe towering out of the undergrowth. One shot each—from our cameras—and he went off to join his wife and child, moving with an incomparable grace which by some strange paradox strikes one as ludicrous.

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The Turkana tracker waved me on. I approached the thorn bush

cautiously and gazed intently into the scrub beyond. Some fifteen yards away and partially hidden by the grass lay an elongated yellow shape. "Certainly not a lion," I thought. But a more careful scrutiny revealed, just beyond the yellow shape a raised, dark and hairy patch. I lifted my ·450 and fired. A moment's commotion and then out to the left appeared a magnificent maned lion, head well up and apparently unharmed. He turned and stood facing me some twenty yards away. I had reloaded the right barrel, so, feeling rather pleased that the bush was still between us, I let him have it in the chest. He staggered but collected himself and came cantering round the bush. As he appeared I fired again and stopped him; but he was again trying to close and both my barrels were empty when Hoot's ·470 put him down for good.

Nine feet he measured, and a hind foot had been shattered by my first shot as he lay dozing with all four legs in the air.

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During the subsequent week oryx, impala, water-buck and Grant's gazelle were added to the bag, and then on the advice of my agent I returned to hilly country to try for a buffalo.

A nine-foot lion.

The end of a perfect day.

The theory of African buffalo-hunting in the hills is that of bison shooting in Burma. You get up before daylight and hope to find your quarry feeding in open patches on the woody hillside. Not an easy game with either bison or buffalo, and often resolves itself into a stern chase through dense jungle; rather a hopeless job, or so I found it. The African trackers I employed, Masai, Kikuyu, and Turkana were excellent and seemed able to deduce the movements of game from surprisingly little evidence. The better ones had no qualms about following buffalo into thick stuff, and many a time a crash and a thunder of hooves a matter of yards away with perhaps the ghost of a disappearing black shape was the first I knew of the presence of buffalo. I cannot say I liked it. I asked my host's advice and he, not being personally interested in shooting, lent me a book, a relevant paragraph of which read: "Hunting buffalo in thick jungle is always an exciting and often a dangerous procedure." It then went on to advocate shooting them in the open. But

there wasn't any open. It was not until after many days of excitement and wasted effort that at last I saw a bull buffalo's neck above my sights—that and his head were all that were to be seen—and he died at the first shot.

The buffalo is much respected in Kenya and my agent had so filled me with tales of his prowess (and hints of my own inefficiency) that it was with more relief than self-congratulation that I returned to less exciting sport. Someone had mentioned pig. . . .

. . . . . .

"There he goes," shouted R., as a lumbering black body, overweighted forward by glinting tushes, went off at amazing speed, his tail well up. Rex, the lurcher, had already changed into top. Dodging the gum trees and thorn we made what speed we could, but the hog kept his place in the lead long enough to put the issue in doubt. The nature of the country, however, was against him: not a sizeable bush within a mile and not a hole to be seen, so a rattling gallop finally resulted in Rex connecting with the pig's less dangerous end. I was all but off as my pony shied from a vigorous charge, but Rex's war of attrition in the rear at length enabled me to get in a good spear—R. holding off like a gentleman until blood was drawn.

This was the 793rd pig at whose obsequies he had assisted since 1930. A reserved and modest man is R. For pig he uses a bayonet tied to a stick—he prefers to kill his pig on foot and finds the bayonet handier than a hog spear. For cheetah a riding switch and a rope suffice. Having ridden his cheetah to a standstill (for although very fast they are quickly burst if pressed), R. gets off and seizes a hind leg. The cheetah strains away and is then tapped gently with the whip on each side of the head to prevent him turning over and misbehaving. A noose is passed quietly round the hind leg and made fast to a tree, and R. rides back for assistance in leading his catch home—a second noose round the sharp end sufficing. Two captives in his stables and a pet cub in the house were evidence of his prowess.

The African pig does not always give such a good run as I have described. In some places holes are plentiful and the visitor is surprised to see the pig suddenly back away out of sight. The hole, however, is shallow and one is welcomed when approaching on foot by a hideous black face and large fierce-looking tushes. The hog may come out at once but more often needs the inducement of a spear prick in the face—and then the fun begins. A bayonet is certainly handy but holds a pig much less efficiently than a hog spear. I do not recommend this form of sport to anyone hunting alone.

. . . . . .

A few quiet days trout fishing preceded my departure from the highlands. The rainbow trout has been introduced here and does exceptionally well. Occasionally a big fish is netted, but one is pleased to average three-quarter pounds for the day. Rivers are much overgrown and often steep-sided so that not only is accurate casting very difficult but a day's fishing of some rivers may be quite a day's work.

August 25 found me back in Mombasa with leisure to sample the fleshpots. The weather was still delightful though now warming up a little, our hotel was on an arm of the sea, the cuisine and the company were alike excellent. And while we bathed and sailed and fished or basked in the sun or even lay late in bed of a morning it was borne in upon me that much pleasure, in our middle years anyway, lies in the retrospect.

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Kenya is a land that welcomes the visitor and goes out of its way to make him return. To anyone of moderate means who contemplates a short leave there I would say: "Go! You won't be disappointed." Should money be no particular consideration, the employment of a well-known agency will doubtless give the best results; but sport may be had without much expense by arranging small local safaris. Besides, the settler, best of fellows, is hospitality itself. I hesitate to speak of my debt to those kind people who put me up and gave up their time to provide me with sport lest they should be swamped by an invasion of other hungry hunters; but I believe their hospitality knows no limits. I look forward to meeting them again.

Echoes of the Past.

WAR EXPERIENCES OF A TERRITORIAL MEDICAL OFFICER.

By Major-General Sir RICHARD LUCE, K.C.M.G., C.B., M.B., F.R.C.S.

(*Continued from p.* 134.)

Chapter XII.—The Imperial Mounted Division.

By the end of January, 1917, a large portion of our Western Force troops had been shifted to the Eastern Frontier and more were soon to follow.

A new Mounted Division called the Imperial Mounted Division was being formed and in the first week of February I was given the post of Assistant Director of Medical Services in it.

The postion of affairs on the Eastern Frontier had changed greatly since the beginning of the previous year. Most of the troops brought back from Gallipoli had been stationed along the Suez Canal in case the Turks might use the forces released from Gallipoli to repeat their attack on Egypt across the Sinai Desert.

In 1915, with his small forces and their complete lack of knowledge and equipment for desert warfare, Sir John Maxwell had been obliged to make the Canal itself his line of defence.

Sir Archibald Murray, who was appointed to the Command of the Eastern Defences in January, 1916, with greatly increased strength and with troops that had learned to fight in the hard school of Gallipoli, decided on a bolder course. Starting with the assumption that he had to defend the Canal and not allow the canal to defend Egypt, he constructed a strong line of defences on the east side of the Canal. It extended along the whole eighty-five miles of the Canal at a distance varying from two to ten miles from it, and this line was connected with a second line on the eastern bank of the Canal itself, by short railways. An immense amount of labour and material was put into these works which were fairly well complete by the middle of March, 1916.

Sir Archibald then began to stretch out feelers into the desert and to strengthen his own defences by denying to the enemy such posts on the main routes across the Sinai Peninsula as might be useful to them as watering places in an advance. Expeditions were sent out to these places and several large water stores were drained and destroyed, besides many wells.

There are three recognized routes across the Sinai Peninsula, but the only practical one for a large force is the northern one which leaves Palestine at Rafa and following the coast passes through the town of El Arish and then by a series of oases reaches the Canal at Kantara. This was not the route used by the main body of Turks in the expedition of the previous year. They came by a track which starts from Auja, almost due south of Beersheba, and reaches the Canal at Ismailia.

The nearest important watering place to the Canal on the northern route is the oasis of Katia, which contains a series of wells of varying salinity. Katia was now occupied by the 1st South Midland Mounted Yeomanry Brigade, and a party of engineers, escorted by two squadrons of the Worcesters, went forward to the further post of Oghratina to destroy the wells there.

The Turks did not allow this move to pass unchallenged. The Yeomanry soon found that they were in touch with a considerable force of the enemy, which was reported to be occupying an oasis called Mageibra, twelve miles to the south of Katia, and the Brigade Commander of the 1st South Midland Mounted Brigade went off with about half the brigade to attack them. This curiously was the very moment that the Turks had selected to attack Oghratina, Katia and the next post behind called Dueidar. The camp at Mageibra was found practically deserted, but the Turks had better luck in their venture. Oghratina was rushed in a mist and the garrison wiped out or captured. Katia, after a sharp struggle, was also overpowered with considerable losses to the garrison and Dueidar itself was only saved by the heroic defence of its garrison, a company of the Royal Scots belonging to the 52nd Division. The Turks were beaten off with considerable losses. In their retreat they passed the residue of the Mounted Brigade withdrawing from Katia and here was seen the remarkable

spectacle of two retreating and discomfited forces passing within sight of one another each too tired and too dispirited to attack or molest the other.

It was seen that nothing further could be done in the way of active operations against the Turks until the railway and water supply were brought up to the posts now occupied. It had been decided to make a standard gauge railway line out into the desert from Kantara along the northern route and at the same time to lay side by side with it a six inch water pipe. The water was obtained from the sweet water canal which, supplied by a canal from the Nile, runs along the east side of the Suez Canal from Ismalia to Port Said. The water was pumped across the Suez Canal into reservoirs where after sedimentation it was filtered and purified by the addition of chloride of lime. The pipe line was eventually prolonged right up to Gaza, one of the most wonderful engineering feats of the War.

By July, 1916, the railway and pipe line had reached Romani, a few miles west of Katia, and by this time Sir Archibald Murray was definitely committed to a forward policy. The Turks, however, determined to make one more effort to stay his progress by delivering an attack in force on our railhead.

They employed a force of about five thousand and their plan was to move past or level with our railhead at Romani and then by turning north to attack our defensive positions from the south and south-west. The attack was delivered on the morning of August 3. Our southern flank was held by the mounted troops, the Australian Light Horse and the Yeomanry. The brunt of the attack fell on them and at one time it looked as if they would be driven in on to the railway. However, the force of the attack was broken and after the arrival of infantry reinforcements the scales were turned and the Turks retreated with heavy losses, pursued by the mounted troops. This was the last attempt the Turks made to stay our advance on Palestine by any definite offensive effort. During the remaining months of the year the railway and pipe line pushed on steadily across the desert at the rate of about a mile per day and as it advanced the cavalry pushed on in front, fighting a series of gallant actions at Mazar, Maghdaba and finally at Rafa. Often the day was only won by the determination of the troops after the Commander thought it had been lost. Magruntein Hill, commanding the frontier village of Rafa, was captured on January 9 and now the desert was crossed and the Promised Land in sight.

The leading infantry division, the 52nd, marched the whole weary way from Kantara to Gaza, but after Romani never came up in time to take part in any of the battles of the advance.

The force at the disposal of Sir Archibald Murray in February, 1917, for the advance into Palestine, consisted of two mounted divisions, the Anzac and the Imperial Mounted, the Imperial Camel Corps Brigade, and three Territorial Infantry Divisions—the 52nd (Lowlands), the 53rd (Welsh) and the 54th (East Anglian). It was known as the East Force and was commanded by Lieutenant-General Sir Charles Dobell. The two

cavalry divisions, the Imperial Camel Corps and the 53rd Division, formed a subordinate command under Lieutenant-General Sir Philip Chetwode, known as the Desert Column. The Anzac Division was made up of the 1st and 2nd Australian Light Horse Brigade, the New Zealand Mounted Brigade and the North Midland Mounted Brigade. It was commanded by Major-General Chauvel. Our own division, the Imperial Mounted, contained the 3rd and 4th Australian Light Horse Brigades and the 5th and 6th Mounted Brigades of Yeomanry, formerly part of the 2nd Mounted Division and then known as the 1st and 2nd South Midland Mounted Brigades.

We were commanded by Major-General Hodgson who had recently commanded the successful motor car expedition to Siwa which had ended the Senussi Campaign on the Western Frontier of Egypt. His staff consisted partly of old members of the Western Frontier Force, like myself, and partly of Australians.

It was a mixed team, the elements of which belonged to very different schools. Not unnaturally, it took a good deal of shaking down to form a homogeneous and smoothly working staff.

The 3rd Light Horse Brigade was commanded by Brigadier-General Royston, a fine old South African who had taken part in all the fighting in South Africa since the Zulu war. He was known to his men as "Galloping Jack" and beloved by them as a hard rider and a hard fighter.

The 4th Light Horse was still in process of formation. It was commanded by an Australian doctor, Brigadier-General Meredith.

The 5th Mounted and the 3rd Light Horse Brigades were already up at the front. Our Divisional Headquarters and the other two brigades assembled at Ferry Post on the east side of the Canal, about three miles from Ismailia, on February 18, 1917.

Our headquarters was a stone's throw from the swing pontoon bridge which crossed the Canal close to the point where the latter opens into Lake Timsah, the first of the salt water lakes. On the west shore of the lake lies Ismailia, the beautiful little town which is the headquarters of the Suez Canal Company. It was there that Sir Garnet Wolseley disembarked his army in 1882 for the advance on Cairo which resulted in the battle of Tel-el-Kebir.

On the high ground on the opposite side of the Canal was the French hospital which had been used as Sir Archibald Murray's Headquarters until he moved to Cairo in October, 1916. It was now occupied by Sir Charles Dobell and the staff of East Force. At the time of our arrival they were just packing up to move up the line to El Arish.

The medical arrangements of the new division were on similar lines to those of the old 2nd Mounted Division. Each brigade had a mounted brigade field ambulance. The establishment of an Australian mounted brigade field ambulance differed in some particulars from a British one, chiefly in that all their bearers were mounted. This was an enormous

advantage to them for their work in this campaign. The field ambulance of the 4th Light Horse Brigade was not yet in being and at first, owing to shortage of medical officers and personnel, had to be content with one section instead of two.

For work in the desert considerable changes had been made in the organization and equipment of the field ambulances, though their establishment of personnel remained as before. Motor ambulances were quite useless on the Sinai Peninsula as the surface of the Sinai desert is different from that of the Libyan desert on the West Frontier where motors had proved so invaluable. The regulation pattern horsed ambulances, light and heavy,

Sand-cart for carrying patients.

were also unusable in the deep sand. To take their place, the sand cart had been devised and issued to all units. But the great majority of the wounded had to be carried on camels by means of one of the various forms of litter or cacolet. Many patterns of litter were tried, but none was ever found that could make travelling on a camel anything but misery to a seriously wounded man. The original pattern, called a *kajavi*, consisted of a couple of canvas coffin-like troughs slung one on either side of the camel. It was said to have been designed by Larrey, Napoleon's famous medical officer, for their march across the desert during the invasion of Palestine in 1800. Then a folding iron litter with a canvas bottom lashed to the iron frame, like the old-fashioned military hospital bed, was tried. Next, an attempt was made to utilize the regulation military stretcher by fixing a pair of them to the saddle of the camel with iron clamps. A great many of this pattern were made but they proved a hopeless failure. The iron framework was always getting bent so that it would not take the stretcher and even when it did, the patient, who had to be strapped on, was as often as not found with his

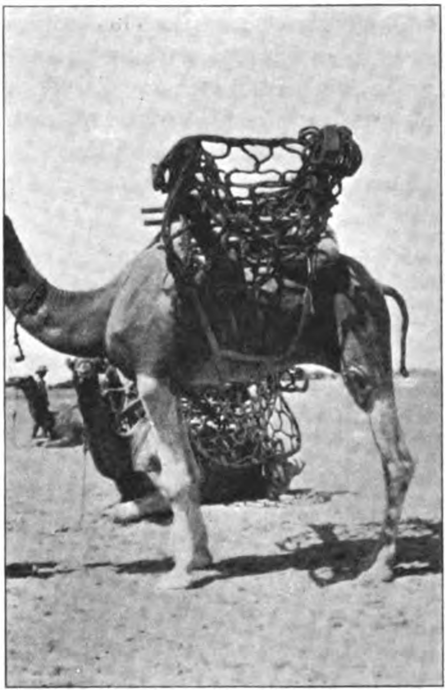
head a foot or so below the level of his legs, owing to the fact that the stretcher was not held rigidly enough in the horizontal position. The object of this design was to enable the patient to be loaded on the camel without having to make the camel lie down. To a wounded man the the motion of a camel in rising produces extreme torture.

The final pattern was cribbed from the Turks. It consisted of a light wooden frame with a canvas bottom and a rail round it to keep the patient

Camel litters, Turkish pattern.

in. It was constructed so that the back part was set at an obtuse angle to the front part, the patient, therefore, lay in a half reclining position instead of flat. This was a disadvantage for fractures of the thigh and serious abdominal or head injuries, but it ensured that however much the litter shifted the patient's head was at least as high as the rest of him. A half awning was fitted to protect the patient's head from the sun. The sitting cacolets of the old folding pattern were much used as we had a great many of them and they were comparatively light, but they were tiring and uncomfortable and only suited for lightly wounded cases.

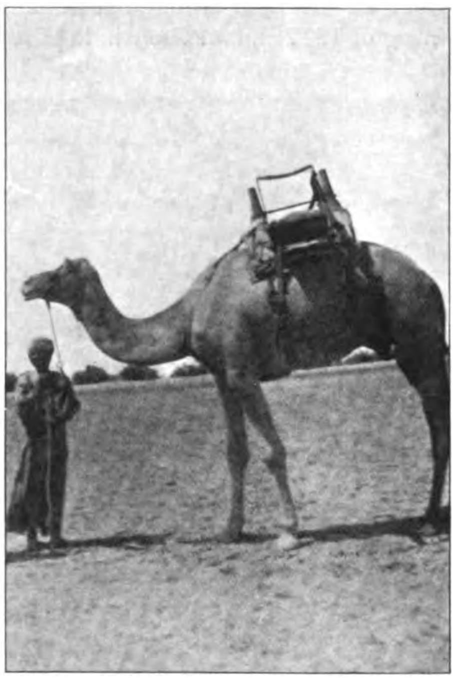
The sand cart proved a great success. It consisted of an iron frame supported on two wheels, with light sides. The floor of the cart was simply an iron woven spring mattress divided into two parts by a central board which could be taken out. The cart was covered with a canvas hood



Camel nets arranged for carrying patients.

Carrying patients in camel nets.

supported on wooden bales. For desert work the wheels were fitted with an additional iron tyre, six inches broad, to prevent the wheels from sinking into the sand, and it was found a great additional advantage to fit two canvas drum heads into the inner and outer rims of the tyres so that the sand could not ride over the edge of the rim. This contrivance, if made sand tight, greatly lightened the draught of the vehicle. The cart was fitted with a pole and was drawn by four or even six mules when the sand was very soft. With such a team it could go anywhere and the mules could do



Camel cacolets.

their long journeys without getting knocked up. Another method of carrying wounded of which much was expected and something effected was the sand sleigh. Various patterns were designed and used by different field ambulances. The simplest form consisted of a sheet of corrugated iron with the front end bent up and kept in position by wires. As regards motion this proved a very comfortable means of progression for the wounded man. The chief drawbacks were that the patient became smothered with dust and that they were very heavy in draught for the mules; but, most serious of all, they cut the ground telephone wires of the Signal Service as they passed over them. This fault brought them into evil repute with the higher powers and finally led to their condemnation.

A light double bicycle-wheeled carrier to take one stretcher and drawn

by one mule was much fancied by some units and for a time became official, but it was liable to upset and the wheels easily buckled.

Modifications to meet the special transport difficulties had been made in the organization of both the infantry and mounted field ambulances. Of the three sections of the former and two of the latter, one was deprived of its transport and was termed Immobile. The immobile sections thus rendered incapable of accompanying their brigades were practically tied to the railway where they were able to form dressing stations or lightly equipped clearing stations. Camel transport took the place of all wheeled vehicles for carrying the equipment of the field ambulances. This organization held good until the beginning of 1917 and on the whole proved very satisfactory.

El Arish.

The regulation water carts were withdrawn and water was carried in twelve-gallon copper-plated tanks called *fanattis*. A pair of these slung one on either side formed a load for a camel.

I brought two clerks from the Western Force who had been with me from the start of the 2nd Mounted Division and knew the routine office work so that I was able to devote all my time to getting in touch with the medical units and regimental medical officers of the Division assembling at Ferry Post.

On March 1 our Divisional Headquarters moved up by train to El Arish. The 6th Mounted Brigade with the artillery was already on its way marching across the desert. The 4th Australian Light Horse Brigade and its one section field ambulance were not yet ready and did not join the Division until more than a month later.

At El Arish we found the headquarters of the East Force. That of the Desert Column, to which we now belonged, was just moving one step

further forward to Rafa. We found the 3rd Light Horse Brigade encamped by the sea at Masaid, about three miles south-west of El Arish. Our own camp was on the edge of the sea a mile to the north of the town.

El Arish is a little town near the mouth of the river which in the Bible is referred to as the "River of Egypt." This is not a flowing river all the year round but its bed and the ground near it furnish many wells which enable a successful cultivation of fruit trees and other crops to be carried on. Prior to the War El Arish was the centre of the Egyptian Government in Sinai. At this time the railway had reached a point twenty miles north of El Arish and was within a few miles of Rafa, the frontier village.

The 5th South Midland, our other brigade, was encamped at El Burj, ten miles beyond El Arish. I at once paid a visit to their field ambulance and renewed my old association with them which had been broken on the day we started for Gallipoli, eighteen months before. When we returned from the Peninsula, separated from their brigade, they were operating with the Western Force against the Senussi on the coast, west of Alexandria. There they did most excellent work and gained great credit. Before the Western and Southern Forces were amalgamated they had been sent to the Canal to join their own brigade. They were present with the Brigade at the time of the surprise at Katia and a small detachment with a medical officer was captured by the Turks.

The 3rd Australian Light Horse Field Ambulance I met now for the first time. It had been through all the operations across the Sinai desert and was an experienced and thoroughly efficient unit.

The Australian medical officer is well adapted for work with a medical unit in the field, especially with mounted troops. He is resourceful and self reliant, and from first to last in dealing with Australian troops I could always be certain that they would never fail to get their casualties away, however great the difficulties of transport might be. The same was true of our own Territorial Mounted Brigade field ambulances which were exceedingly well officered and commanded and had now become thoroughly experienced in war.

On March 9 our Divisional Headquarters moved ten miles further up the line to El Burj. We left our heavy kit behind at El Arish and henceforward we lived under strictly field conditions in bivouac tents, though I was still allowed a bell tent for an office. The assembly of the three brigades was now almost complete as units of the 6th Mounted Brigade were arriving one by one after their long march across the desert.

While we were stationed at El Burj it fell to my lot to have to go down to Cairo to lecture on Medical Organization in the Field, at the Staff College which had been opened in the hotel at Mena. It was a long journey to take for an hour's lecture, but a pleasant change. The railway journey down to Kantara in a hospital train which ought to have taken eight hours, this time took thirty hours. There was a severe dust storm blowing which completely buried the rails in some places in a few hours.

We were derailed twice and several times held up for many hours while other trains in front of us had to be dug out of the drift sand. The delay made me twenty-four hours late for my lecture, but fortunately it could be postponed to the following day. The preparation for the lecture in the field was a difficult business. The only paper available for diagrams was sheets of foolscap which had to be gummed together. After I had got these ready they were laid aside in the office tent. Next day they were nowhere to be found. A very strong wind was blowing and eventually one of the three was found resting against a fig tree more than a hundred yards away to leeward. The others were never found and had to be hurriedly prepared again.

When I got back from Cairo I found we had moved forward a stage to Sheik Zaweid. Here we were camped once more by the sea, separated from the railway by the high sand dunes which all up the coast form a barrier between the cultivated plain and the beach. These dunes, often 100 feet high, consist of soft drift sand and are difficult to cross either on foot or mounted. In some places they are two miles across but generally less. One of the peculiarities of this coast is that on the beach between the sea and the dunes fresh soft water can be found almost anywhere by digging a few feet into the sand and this right up to the margin of the sea. It was quite common for the shallow wells we dug and from which we obtained beautifully soft fresh water, to be inundated by the sea in rough weather and filled in. A few hours later, when the sea had calmed down, a new well could be dug in the same spot and would give water as fresh as ever. On the other hand wells on the plain, inland from the dunes, had to be dug quite deep before water was reached at all, and then it was sometimes quite brackish and always of high salinity.

The explanation given by the geologists is that the dunes, acting as a sponge, hold a large amount of rain water taken up in the rain season. This gradually percolates to the base of the dunes on the shore side and moving steadily forward beneath the surface of the ground towards the sea, holds back the sea water. This fact was an inestimable boon to troops moving, as mounted troops often did, along the beach.

The shore sand wetted by the waves makes excellent going for horses though the rest of the beach, where the sand was dry, was very heavy. Bodies of mounted troops could be sure of finding plenty of water both for themselves and their horses at almost any point they liked to halt on the beach, however great their numbers.

We moved on to Rafa on March 22 and were now on the frontier of Palestine itself. The headquarters of the Desert Column was already established there and the Headquarters of the East Force moved in a day or two later.

The Turks, after their defeat at Rafa on January 9, withdrew across the Wadi Ghuzzeh, which runs into the sea about four miles south of Gaza, and began fortifying the town and its surroundings.

Some time before they had prepared a very strong line of defence at Shelal, about a mile to the south of the Wadi and about eight miles from the sea. Much labour must have been expended on it, but after the battle of Rafa they decided not to hold it.

On March 3 our Division was ordered out from Rafa to make a reconnaissance in force towards Gaza and to explore the Wadi Ghuzzeh and find out its capabilities for producing water for the troops.

After a long ride out our Headquarters took up position on a hill about half a mile south of the Wadi, whence we had a view across it to the outskirts of Gaza. Except the minaret of the mosque and a few houses on the top slopes of the hill, the town cannot be seen from the south. Lying about two miles from the sea, it is guarded on the south by low hills which stretch across to the sea. The ground is covered with cultivation broken up into small fields by almost impenetrable cactus hedges. To the south-east it is overshadowed by a prominent conical hill known as Ali Muntar, which forms the main defence of the town on the land side. This hill had been carefully trenched. It was a formidable fortress and played a most important part in the subsequent attacks.

On this day our covering troops were fired on from the defences but no definite engagement took place. During our withdrawal the Turks closely followed us up with aeroplanes and caused some casualties with machine gun fire to the Yeomanry of the 5th Brigade. By evening we were all back in our camp at Rafa.

(*To be continued*).

Current Literature.

MOLITCH, MATTHEW, M. D., Jamesburg, N. J. **Dihydroxy-anthranol in the Treatment of Ringworm of the Face, Neck and Arms** (*Tinea circinata*). *Journal of the American Medical Association.* Vol. 106, No. 18, May 2, 1936.

Amongst school children in the New Jersey State Home for Boys cases of skin disease were constantly coming for treatment. New boys were not usually infected on arrival and the disease was probably contracted by contact or indiscriminate use of towels or clothing. Over a period of four years skin lesions were treated with various ointments, including ammoniated mercury, and antiseptics such as gentian violet and tincture of iodine in varying percentages. With persistent daily treatment the lesions, which were in a fairly early state, i.e., from one-half to three inches in diameter, would clear up in one or two weeks.

Ointment containing 0·1 per cent dihydroxy-anthranol was tried and found to be non-irritating and only feebly effective. 0·5 per cent ointment however was found to be non-irritating and effective. One application caused, within a few hours, a light purplish discoloration of the skin adjacent to the lesion. On the second day the skin crinkled and on the third or fourth day it desquamated. No scar or other complications resulted in twenty-four cases treated. There was a fall in the incidence in the school of skin lesions which suggests that complete sterilization of the lesions treated had occurred.

Dihydroxy-anthranol differs from chrysarobin only in the lack of the methyl group. [It is reported also as being useful in the treatment of psoriasis (Beriman and others), *Journ. Amer. Med. Assoc.*, vol. 104, 26-28, January 5, 1935].

PROC. ROY. SOC. MED. 1936, v. 29, 481-96 (Sect. of Epidem. & State Med., 15-30). [25 refs.] **Discussion on the Use and Abuse of the Swab in Combating Diphtheria** [PARISH, H. J.; STALLYBRASS, C. O.; ROLLESTON, J. D.; BOUSFIELD, G.; UNDERWOOD, E. A.; O'BRIEN, R. A.].

This discussion is concerned with the bacteriological diagnosis of diphtheria in the light of present-day knowledge. Dr. Parish stressed the fact that in the first place the responsibility of diagnosing the disease must rest with the clinician. Only on such conditions will antitoxin be given at the earliest possible moment. It is specially important that the swab should be taken in an expert manner. Not only are many patients admitted to fever hospitals in whom the diagnosis cannot be confirmed but also many of the confirmed cases have been given antitoxin relatively late in the disease. It is unfortunate that patients cannot be sent to hospital for observation and that they have then to be notified as definite cases of the disease. In discussing the actual technique of bacteriological diagnosis Dr. Parish was of the opinion that a tellurite medium must be used as well as Loeffler medium. Neither of these two types of medium can replace the other. Tellurite media sometimes give an atypical smear picture but properly used they lead to 10 to 25 per cent more positive results. [Detailed technical procedures are suggested.] Dr. C. O. Stallybrass gives an analysis of figures obtained in Liverpool illustrating the uses and deficiencies of swab diagnosis. It appeared that the average delay in sending for the doctor was much greater in fatal cases than in other cases. The delay between sending for the doctor and the patient receiving his first dose of antitoxin was twice as great in fatal cases as in ordinary cases. The average age of fatal cases was half that of non-fatal cases, yet younger children appeared to escape swabbing much more than adults. An analysis is given of fourteen fatal cases. Delay on the part of the parents in seeking advice probably accounted for nine of the deaths and delay on the part of the doctor for two of the deaths. The time spent

in taking a swab did not appear to contribute to the fatal issue. In Liverpool it was found that of 1,200 consecutive swabs taken during 1935 37·2 per cent were *gravis*, 34·5 "intermediate," and 30·7 *mitis*. A further survey of 108 consecutive admissions to Fazakerley Hospital gave 37·2 per cent *gravis* (with two deaths), 45·8 per cent "intermediate" (with three deaths), and 17 per cent *mitis* (with no deaths). Dr. Stallybrass recounts two instances of cross-infection with different types during a patient's stay in hospital and suggests that it may be necessary to revise current ideas of hospital administration in conformity with such facts. [This being a discussion is not easy to summarize. It represents a helpful and practical contribution to the problem of diphtheria diagnosis as it stands to-day, and it illustrates that a number of time-honoured ideas on the subject have got to be revised in the light of recent knowledge.] C. C. OKELL.

Reprinted from " Bulletin of Hygiene," Vol. 11, No. 7.

HERRMANN, A. **Experiences with Catadyn for the Sterilization of Water.** *Schweiz. Apoth-Ztg.* 1934, v. 72, 599. [Summary taken from *Dept. Scient. & Indust. Res., Water Pollution Research. Summary of Current Literature.* 1936, v. 9, 117.]

The Krause Catadyn process for sterilizing water is described. The suitability of the process for sterilizing distilled water for pharmaceutical purposes was investigated. Distilled water was found to contain up to 1,260,000 bacteria per cubic centimetre. Chains of cylinders bearing silver prepared by the Krause process were hung in a vessel containing about 60 litres of distilled water and the reduction in the number of bacteria was tested after different periods up to twenty-two days. In the four examples tested the water was not rendered sterile. The bacterial count fluctuated irregularly but was finally reduced, in one case to 24 per cent of the initial value, in another to 9 per cent. Spore-forming bacteria, yeasts and mould spores were found to be resistant. Investigations were also carried out with water treated by the Electro-Catadyn process and containing 0·2-0·4 mg. silver per litre. Pure cultures of the colon-typhoid group were killed in two hours so long as the water contained 0·1 mg. silver per litre and the number of bacteria was not greater than 500,000 per cubic centimetre. Some species of streptococci were equally sensitive, *Micrococcus roseus* and yellow Sarcinæ were more resistant, while the spore-forming *B. subtilis* and *B. mesentericus* were almost unaffected. The development of moulds was prevented. The Catadyn process therefore introduces no improvement in the sterilization of water for pharmaceutical purposes. The same effect is shown by silver nitrate or other soluble silver salts when dissolved in water to give an equal concentration of silver.

Reprinted from " Bulletin of Hygiene," Vol. 11, No. 7.

JOHNSTON, E. W. & EDMONDS, W. R. **Interference of Algæ with Tests for Residual Chlorine.** *J. Amer. Water Works Ass.*, 1935, v. 27, 1717-24. [Summary taken from *Pub. Health Engineering Abstr.* Wash. 1936, Apr. 25, v. 16. Signed James H. Le VAN.]

Under certain conditions the presence of algæ may cause a very distinct interference with ortholidin [? orthotolidin] and starch-iodide tests for the presence of free chlorine in water. The reason for this condition has not yet been reported but the following factors appear to be involved: "(1) A straight reaction between the colouring matter in algæ, and the chemicals used in these tests; (2) An oxidation of the testing solution brought about by the presence of atomic oxygen. The fact that both orthotolidin and starch iodide react similarly strengthens this contention. The removal of the oxygen from the plant by sodium thiosulphate also causes a negative reaction, but this returns where the plant is allowed to stand in sunlight."

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 7.

McEWEN, C.; ALEXANDER, R. C.; BUNIM, J. J. **Bacteriologic and Immunologic Studies in Arthritis. I. Results of Blood Cultures in Different Forms of Arthritis** [McEWEN, ALEXANDER and BUNIM]. *J. Lab. and Clin. Med.* 1936, v. 21, 453-64. [31 refs.] **II. Results of Various Immunologic Tests in Different Forms of Arthritis** [McEWEN, BUNIM and ALEXANDER]. *Ibid.*, 465-76. [36 refs.]

I. Blood cultures were made from 310 patients suffering from various kinds of arthritis and from 149 control patients. Hæmolytic streptococci were frequently isolated from cases of tonsillitis and other known streptococcal infections. From 10 to 19 per cent of patients with various forms of arthritis (acute rheumatism, rheumatoid arthritis, gonococcal arthritis and osteo-arthritis) positive blood cultures were obtained chiefly with green-producing streptococci but occasionally with hæmolytic or indifferent streptococci or with diphtheroids. Except in a small group of patients with arthritis as part of a general septicæmia due to hæmolytic streptococci the blood cultures appeared to be of no value in differentiating the various forms of arthritis. No deductions of ætiological significance could be drawn from the observations. [Full details are given in tables of numbers of patients, type of organism, etc.]

II. Gonococcal complement-fixation tests, hæmolytic streptococcus agglutination and precipitation tests, and antistreptolysin and antifibrinolysin determinations were made on a series of patients with various forms of arthritis. Gonococcal complement fixation tests were positive in 98 per cent of forty-four patients with gonococcal arthritis. The sera of 86 per cent of thirty-six patients with active rheumatoid arthritis agglutinated a hæmolytic streptococcus. 66 per cent of fifty-one patients with rheumatic polyarthritis had sera with antistreptolysin titres above normal.

The streptococcal precipitin tests and the antifibrinolysin determinations prove to be of very little value, whereas the other three tests appear to be of definite diagnostic value. C. C. OKELL.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 7.

JONES, E. R. **The Use of Brilliant Green-Eosin Agar and Sodium Tetrathionate Broth for the Isolation of Organisms of the Typhoid Group.** *J. Path. & Bact.* 1936, v. 42, 455-67. [19 refs.]

On 1 per cent lactose-agar plates containing different concentrations of brilliant-green and eosin, varying sizes of inocula containing mixtures of *Bact. typhosum* and *Bact. coli* in varying proportions were spread. Thus an optimum concentration of the dyes was determined and a method is detailed for finding this optimum for the particular batch of dye employed, in the present experiments usually 0·09 per cent of eosin and 0·001 per cent of brilliant green. The medium inhibits *Bact. coli*, the dysentery organisms, *Bact. morgani* and *Strep. fæcalis*, but permits growth of *Bact. typhosum*, the other Salmonellas and *Bact. aerogenes*: Proteus is partially inhibited. Colonies of *Bact. typhosum* are grey-white and translucent, easily picked out from the opaque pink-purple colonies of *Bact. coli*. *Bact. coli* in a heavy inoculum may overgrow *Bact. typhosum* while it would not do so in a small inoculum containing the same proportion of the pathogen.

The pathogenic organisms, except the dysenteries, were likewise favoured by growth in sodium tetrathionate broth. Experimental work having indicated the efficacy of these media, 124 specimens of fæces and urine from suspected enteric fever cases were examined by plating on the eosin-brilliant green medium and on MacConkey's agar after emulsification in tetrathionate broth, replating if necessary after incubation of the broth. The dye medium proved superior to MacConkey, 34·7 per cent of positives being recorded with the former to 14·5 per cent with the latter. Wilson and Blair's glucose-bismuth sulphite-iron medium with brilliant green gave results as good as the dye plates but is more difficult to prepare, does not keep so well after pouring, and does not show the colonies so quickly. J. C. CRUICKSHANK.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 7.

HOHN, J. & HERRMANN, W. Der Kulturtyp der Erreger der Typhus-Paratyphus-Gruppe und seine Bedeutung für die Standortsgebundenheit. [**Type of Culture of Members of the Enterica Group and its Relation to Habitat.**] *Ztschr. f. Hyg. u. Infektionskr.* 1936, v. 117, 722-41. [29 refs.]

The authors record the fermentative behaviour of a large sample of salmonella organisms (*a*) when grown in a particular synthetic medium, with ammonia as the source of nitrogen, and various added carbon-containing substrates, and (*b*) when grown in an optimal nutritive medium (testicular extract) with the addition of some of the same test substrates.

15

On this basis they divide the forty-one species, or types, examined, into three different groups, one of which is further divided into two sub-groups. These groups, as they state quite clearly, bear no relation whatever to the antigenic groups of the Kauffmann-White schema. The authors' fermentative Group I (*a*), for instance, contains representatives of the antigenic Groups A, B, C and D. Their Group II contains members of Groups B, C and D and so on.

[Clearly all workers must be free to approach the problems of systematic bacteriology along such lines as they wish; but unless future attacks on the salmonella bacilli are developed in a more orderly fashion than has been the custom of late, that interesting group of bacteria seems likely to return towards the chaos from which it was recently emerging. The Kauffmann-White classification was based on a well-tested, uniform method of analysis, that had proved itself capable of giving reproducible results in the hands of careful workers. There was general, or almost general, agreement that the distribution of the somatic antigenic components was less clear-cut than that of the flagellar antigens, and a feeling that this part of the antigenic picture needed further study. There would, however, have been very little chance of disagreement with regard to the identification of any salmonella strain belonging to one of the species or types recognized and named by the Salmonella Subcommittee in 1934. That position has not, itself, altered since the report was published; but it seems to some of us that most of the advantages arising from it are being rapidly discarded. New "species" or "types" are being described and named in rapid succession. In some cases the developments are along the lines for which the scheme itself provided, differences in antigenic structure being accorded due preponderance; but in other instances great weight is attached to differences in fermentation reactions, often of quite a minor kind. New fermentation tests are being devised, and if the application of an arbitrary assortment of these divides a labelled "species" or "type" into different enzymic groups or sub-groups, these are cheerfully provided with labels, usually being given the status of varieties. There would seem to be urgent need for the Subcommittee, or some similar body, to recommence its labours, and to introduce some order into the riotous and unco-ordinated growth of the past two years.] W. W. C. TOPLEY.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 7.

KOTELNIKOV, G. F. Ueber Formalin- und Urotropin-Typhus B-Paratyphusvakzine. [**Enterica Vaccines Prepared with Formalin or Urotropin.**] *Rev. Microbiol., Epidémiol. et Parasit.* 1935, v. 14. [In Russian 366-75. (19 refs.) German summary 375.]

The author has taken up the problem of preparing vaccines of *Bact. typhosum* and *Bact. paratyphosum B* which will cause the minimum of reaction, and has experimented with formalin and urotropin, determining

the average minimal bactericidal dose according to the degree of concentration of bacteria and the duration of contact, at thermostat or room temperature. Comparing with heat-killed vaccines he found 0·1-0·3 per cent formalin and 10 per cent urotropin to have the same immunizing properties, whereas the toxicity of the heated was three times as great, and there is not the destruction of the organisms by lysis as is produced by heating. Of the two—the formalinized and urotropinized—the latter is preferable because the former has to be deformolized, and the latter is, therefore, more simple to prepare. The strength of urotropin recommended is 10 per cent for *Bact. typhosum* and 20 per cent for *Bact. paratyphosum B.*

H. H. S.

Reprinted from " Bulletin of Hygiene," Vol. 11, *No.* 7.

Reviews.

JOHANNES DE MIRFELD. By Sir Percival Hartley and H. R. Aldridge. London: Cambridge University Press. Pp. xiii + 183. Price 15s. net.

Amongst much other interesting and learned matter, this volume reproduces selected excerpts from Johannes de Mirfeld's "Breviarium Bartholomei" and "Florarium Bartholomei," the earliest known writings of a medical nature associated with any English Hospital. The "Breviarium" is purely a medical text, while the "Florarium" is largely theological but with some medical interpolations. In the record of his advancement to the order of subdeacon in 1395, John Mirfeld appears under the title of "The Master and Confraternity of the Hospital of St. Bartholomew," and his great compilation the "Breviarium" appears to have been written some time before this date. The excerpts finally selected from the "Breviarium" for publication here, include the chapter on The Signs of Death, and that on Consumption. The original Latin text, with its contractions expanded, is reproduced and is accompanied by an English translation of high literary merit. Mirfeld's medical writings are of the usual scholastic type of his age, following slavishly the precepts of the Fathers and showing no evidence of personal observation. Indeed he disclaims all aim at originality and declares in the Epilogue, "I myself have added nothing of my own to the matter in hand, for the reason that I have not discovered anything of my very own to add." He goes an to explain that his compilation was undertaken to benefit the poor and unlearned who do not possess a plentitude of books.

The volume is fully documented and contains fine facsimiles of parts of the original MS., and in brief exemplifies specialized scholarship at its best.

W. P. M.

"Rolling Home." By "The Idler." London: John Bale, Sons and Danielsson, Ltd. 1936. Pp. 495. Price 8s. 6d.

When a ship sails homeward from a far away port, says the author, the band plays "Rolling Home to Merry England," and he would compare the adventure of life to a little craft rolling from a forgotten harbour, over rough and unchartered seas to a haven which is said to be full of peace. The author is a Surgeon Commander and in his book of 500 pages he gives us the story of his life's adventures and it is a story well worth reading—in all humility he tells us that he has gathered together his recollections just for the benefit or otherwise of his son, but there will be many in his own Service and many outside it who will find it most interesting and entertaining reading. The author has seen much of the queer places of the world and knows how to tell their story. If this book gets into the hands of those of the newly qualified who would prefer a life of interest and adventure to the more profitable routine of private practice, it should bring many a recruit to the Naval Medical Service. A. C. H. G.

The Treatment of Asthma. By F. T. Harrington, M.R.C.S., L.R.C.P. London: H. K. Lewis and Co., Ltd. 1936. Pp. x + 112. Price 6s. net.

This small book of one hundred odd pages sets forth very clearly the author's views on the treatment of asthma. He stresses the great importance of derangements of the alimentary tract in the production of broncho-spasm and shows how great benefit may result from rectifying these digestive defects. Expiratory respiratory exercises to enable the lower part of the chest to regain this important function are described.

It seems to the reviewer, however, that insufficient emphasis has been laid on the importance of the inhalation factor as a cause of asthma in certain cases.

This little volume should be read by anyone interested in the subject of asthma. J. H-S.

Researches published from the Wards and Laboratories of the London Hospital during 1935. By various authors. London: H. K. Lewis and Co., Ltd. 1936. Price 7s. 6d. net.

This volume contains selections of publications from the London Hospital. Aitken and Wilson describe their failure to confirm Bohns' claim that a pressor substance can be demonstrated in the ultra filtrate from the plasma of patients suffering from Volhard's pale hypertension. Bedson describes his diagnostic complement-fixation test for psittacosis. Bland and Canti have shown that this virus of psittacosis can be grown on chick embryo tissue and that a developmental cycle takes place in the virus.

Hugh Cairns has contributed an instructive article on prognosis of pituitary tumours and Crook describes the hyaline changes found in the cells of the pituitary gland in the syndrome attributed to basophil adenoma.

Professor Ellis's article on pyelitis, its significance and treatment, is included; here he describes the remarkably beneficial results obtained from ureteric catheterization in resistant cases of pregnancy pyelitis.

Valuable papers by Donald Hunter and others on diseases showing marked changes in the bony skeleton are included.

This volume brings together the results of much important and valuable research. J. H-S.

Notices.

CONFERENCE ON THE MIDWIVES ACT.

A Conference to consider the new Midwives Act and its operation will be held by the Royal Sanitary Institute in the Central Hall, Westminster, on Thursday, October 22, 1936, at 2.30 p.m.

The Right Hon. Sir Kingsley Wood, M.P., Minister of Health, has kindly consented to preside and to address the Conference, and the discussion will be opened by Dr. John J. Buchan, Medical Officer of Health for Bradford.

THE ROYAL SANITARY INSTITUTE.

The autumn session of training courses for candidates desiring to enter for the examinations held by the Institute for sanitary inspectors and smoke inspectors, for Associateship (in general hygiene and sanitation), and in sanitary science, will commence on Monday, September 21, 1936.

Particulars of the lecture courses and syllabuses of the examinations are obtainable from the Secretary of the Institute, 90, Buckingham Palace Road, London, S.W.1.

ROYAL MEDICAL BENEVOLENT FUND.

Centenary Year, 1936.

Since its Foundation in 1836 the Fund has distributed nearly £400,000 to medical practitioners in financial difficulties due to sickness or infirmity; to their widows and families left without adequate provision; to their fatherless children towards education.

The aims of this Centenary Appeal are :—

(1) *For new Subscribers* to raise the annual income by subscriptions and donations to £20,000. An increase of £6,000 over the present income of £14,103 would enable allowances to medical practitioners to be increased from £40 to £52 p.a., and to dependants from £26 to £36 p.a.

(2) *For special Donations* to create a Fund from which grants can be voted at the discretion of the Committee to—(*a*) Very urgent and distressing cases. (*b*) Towards training the widows and orphan sons and daughters of medical practitioners to enable them to be self-supporting.

Annual subscriptions, or donations, are very urgently needed, and cheques should be made payable to the Honorary Treasurer, and sent to the Royal Medical Benevolent Fund, 11, Chandos Street, Cavendish Square, London, W.1.

SCUROFORM DENTAL SOLUTION.

MESSRS. MAY AND BAKER have prepared a 10 per cent. butoform in glycero-alcoholic solution for local anæsthetisation of mucous membranes. It is used for anæsthetisation of the mucosa before giving hypodermic injections; in interproximal spaces where deep cavities require the use of matrix bands; on the gums, prior to scaling or removal of overhanging margins of fillings, or before using ligatures or clamps; for the removal of fragments of deciduous teeth; on the gums and palate before taking impressions for dentures; for the relief of pain from abrasions, ulcers, etc.; to relieve trismus in cases of impaction.

PROSPECTUS AND REGULATIONS FOR THE DIPLOMA OF THE BRITISH COLLEGE OF OBSTETRICIANS AND GYNÆCOLOGISTS—"D.C.O.G."

THE scope of the examination includes the science and practice of obstetrics with, in addition, post-natal care of mother and child and the disabilities arising from child-bearing, and as regards gynæcology only that Section directly associated with child-bearing. Evidence of experience in, or a knowledge of, major gynæcological operations will not be required.

The examination will consist of :—

(*a*) A written paper.

(*b*) An oral and practical examination, including obstetrical operations on the model, and obstetric pathology.

(*c*) A clinical examination.

The examination will be held in the College House in London twice a year at dates notified in the medical press.

THE REGULATIONS.

Every candidate for the Diploma, in addition to having been entered for at least two years on the British Register of Medical Practitioners, &c., must submit evidence of having held appointments as follows :—

(*A*) *General Medicine and Surgery.*

Six months' resident appointment, after qualification, in the general medical or general surgical department of a recognized general hospital.

For the present, and until the Council shall decide otherwise, candidates unable to comply with the foregoing must produce evidence of having been registered for five years and of having been engaged in the practice of medicine during that period to the satisfaction of the Examination Committee.

(B) Obstetrics.

Six months' resident appointment, after qualification, in a recognized maternity hospital or in the maternity department of a recognized general hospital.

A satisfactory course of resident post-graduate study in obstetrics may in special circumstances be taken into account in the case of a candidate who cannot comply with (*B*).

(C) Gynæcolgy.

Attendance on an approved post-graduate course satisfactory to the Examination Committee.

(*B*) and (*C*) may be combined in one appointment, but the conditions must satisfy the Examination Committee.

(D) Antenatal, Postnatal and Infant Welfare Clinics.

Six months' regular attendance at these clinics in a recognized general hospital or maternity hospital, or clinics under the local authorities where teaching is conducted and at least two clinics a week are held. These duties may be concurrent with (*B*) and (*C*)

For the present, and until the Council shall decide otherwise, evidence from the Medical Officer of Health, or official of a voluntary hospital or other committee, of having been in responsible charge of an antenatal clinic for at least twelve months, may be accepted in lieu of the above.

For the present and until the Council shall decide otherwise, candidates on the Medical Register and who have been practising for at least ten years are eligible to sit for the examination if they can produce evidence to the effect that they have served five years on the staff of a maternity hospital. Attendances on an approved post-graduate course will also count towards assessing the experience of candidates.

Fees of 10 guineas will be payable for admission to the examination, and 7 guineas for re-examination.

BRITISH COLLEGE OF OBSTETRICIANS AND GYNÆCOLOGISTS: REGULATIONS FOR ADMISSION OF MEMBERS.

Applicants for Membership are required to have held approved resident appointments in (*a*) General Medicine and Surgery (six months); (*b*) Obstetrics (six months); (*c*) Gynæcology (six months); and (*d*) to have attended an Antenatal, Postnatal and Infant Welfare Clinic (six months).

(*b*) and (*c*) may be combined in one appointment of not less than a year. (*d*) may be concurrent with (*b*) and (*c*).

Candidates fulfilling the above requirements must subsequently: (1) Submit complete records of selected obstetrical and gynæcological cases; (2) submit two commentaries on some obstetrical, and gynæcological, subject illustrated by the recorded cases; (3) pass a written, clinical, and *viva voce* examination.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

Correspondence on matters of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a nom-de-plume.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts in the case of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Reprints or excerpts, additional to the above, can be furnished on payment if specially ordered at the time of submission of the article for publication.

Communications in regard to editorial business should be addressed—"The Editor, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, War Office, Whitehall, London, S.W. 1."

MANAGER'S NOTICES.

The Annual Subscription for the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is £1 payable in advance. Single copies, 2s. 6d. per copy.

Cheques, etc., should be made payable to the "Journal R.A.M.C.," and crossed "Holt & Co."

Each subscriber who pays his subscription direct to the Manager will also receive monthly a copy of "The R.A.M.C., The A.D. Corps, and Q.A.I.M.N.S. *News and Gazette.*"

Communications in regard to subscriptions, change of address, etc., should be addressed "THE MANAGER, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, A.M.D.2, WAR OFFICE, WHITEHALL, LONDON, S.W. 1."

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CONTENTS.

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Journal
of the
Royal Army Medical Corps.

Original Communications.

THE UNPADDED PLASTER CAST.

By Colonel J. M. WEDDELL, F.R.C.S., K.H.S.
Consulting Surgeon to the Army.

The following principles should be aimed at in the treatment of fractures: (1) Complete and accurate reduction under radiographic control; (2) absolute fixation of the fragments until firm bony union has taken place; (3) functional use of the limb during the period of immobilization.

The second and third of these can best be attained by a close-fitting plaster cast, augmented in suitable cases by wires or pins through the fragments incorporated in the plaster, and by the use of walking irons in certain lower limb fractures.

The principle of the application of the unpadded plaster cast is the use of supporting plaster slabs which are retained by circular plaster bandages. Plaster bandages should never be applied round a limb unless over a plaster slab. To ensure success and avoid catastrophes, attention to certain points is essential: the use of suitable materials and meticulous attention to details, some of which may appear trivial in themselves, but nevertheless make all the difference to the results.

Materials.

The following have been found the most suitable: (1) Plaster—Terry's Italian Fine or Superfine, put up in airtight tins, sizes 7 lb. or smaller; (2) bandages—Book Muslin No. 14 prepared by R. Bailey and Son of Stockport. Useful sizes are 6 inches by 6 yards and 4 inches by 6 yards;

(3) strong scissors for cutting the slabs; (4) muslin bandages, 4 inches; (5) plaster cutters of the Lorenz type.

With properly prepared and applied plaster slabs the use of strips of metal or other substances to reinforce the plaster is quite unnecessary.

Preparation of the Bandages.

To ensure standard and uniform results it is better that the same person should prepare the bandages, and it is as well for one of the theatre orderlies to be trained for this purpose. Bandages prepared in different wards are apt to vary in rolling and consistency, and are unsatisfactory. A smooth wooden board is used for rolling the bandages. This is dusted over with plaster and a bandage is placed at one end. The bandage is gradually unrolled, plaster dusted on and worked in with the palm of the hand and the bandage re-rolled as the plaster is incorporated. Care must be taken not to roll the bandage too tightly, especially the first few layers which will form the centre, so that when soaked water can penetrate evenly.

The quantity of plaster for each bandage and the correct degree of tightness in rolling can only be learned by experience. If rolled too tightly the water will not permeate through to the centre, if too loosely the plaster dust drops out. The finished bandages should be uniform in weight.

It is useful to mark the outer loose end of the bandage with a *blue* pencil so that the end is easily seen when unrolling for application. When finished the bandages should be evenly stored on their sides in a metal box with a close-fitting lid.

Preparation of the Plaster Slab.

Rubber gloves should be worn. The plaster bandage is submerged lengthways in a bowl of lukewarm clean water, and left until bubbling stops (one and a half to two minutes). The bandage is then lifted out with both hands, held horizontally, and the ends gently squeezed, so that the water runs out of the middle of the bandage without taking too much plaster with it. The more water allowed to remain in the bandage the wetter the slab will be, and the longer it will take to harden and dry. Large bandages for body casts should be definitely wet as these take longer to dry and thus will give time for moulding and smoothing the cast. Extremely wet bandages are awkward to use as they twist easily in unrolling and the centre then falls out.

Slabs for small casts, e.g., wrist and ankle, may be fairly dry so that the setting is more rapid. Often the reduction of the fracture and extension must be maintained by hand until the cast has hardened. In any case the slab must be quite soft and pliable so that it may be accurately moulded to the part, avoiding wrinkles, folds and dead spaces which will give rise to pressure disturbances.

For making the slab, a stainless steel or glass-topped table is suitable on account of the smooth surface and the ease with which dried plaster can

be removed. The desired length for the slab is now marked off—with a grease pencil on the metal or glass—the moist bandage is unrolled backwards and forwards into superimposed layers until the requisite thickness has been attained. The operator smoothes each layer with the ulnar margin of the gloved hand so that all air-bubbles, creases and wrinkles are smoothed out and the layers adhere together. The slab is then slid off the table and is ready for application.

The following remarks apply to casts for the upper and lower extremities.

Application of the Slabs.

The smoothed and pliable slab is applied to the part. There is no necessity to shave the skin, as the close fitting plaster adheres to the separate hairs and the pull being evenly distributed is not painful. In about three weeks the hairs die and then removal of the plaster is painless—a fresh crop of hair will grow. In the upper limb the slab is applied to the extensor surface and in the lower limb to the flexor surface. The slab is carefully moulded to the limb with the flat of the hand. At points where the slab has to round prominences, as at the flexed elbow and the heel, the edges are cut with strong sharp scissors, one-third of its width on each side and folded over to prevent wrinkling. At the flexed elbow reinforcement of the cast at the sides is necessary otherwise the cast is liable to crack.

Once the slab has been moulded into position there must be no further alteration of the position of joints as this will produce wrinkles in the plaster and pressure disturbances will occur in the skin. The slab, when moulded on to the limb will adhere to the skin and is retained in position by a muslin bandage. This may be applied wet and should be put on smoothly and not too tight and should not cause folds or unevenness in the cast.

A second slab may be applied to the opposite aspect of the limb if desired and retained with muslin bandages. Wet plaster bandages are now applied round the limb over the slabs to complete the cast. They are applied loosely, the bandage being simply unwound round the part. The turns should overlap by about two fingerbreadths and should form a neat spiral. When sufficient plaster bandages have been applied and while the cast is hardening, it should be carefully smoothed and moulded over the bony prominences with the flat hand. Care should be taken not to indent the plaster with the tips of the fingers or thumb, even when testing the hardness of the cast, as this will cause indentations in the plaster and pressure disturbances will result.

Before smoothing, the gloved hands should be washed to remove adherent particles of dried plaster. Talcum powder dusted on the drying surface and worked in with the hands, gives a good smooth finish which

will not pick up dirt. The plaster at the bottom of the bowl in which the bandages were soaked should not be used for this purpose as it will not set properly, and when dry will crumble and fall off, leaving rough defects on the surface.

Finally dates and data concerning the fracture should be written on the plaster with indelible pencil. A simple sketch from the radiograph showing the site of fracture is also a useful record.

Observation of the Patient after Application of the Cast.

After the application of a cast the condition of the patient must be carefully watched. The chief danger of the unpadded cast is obstruction to the circulation. Fresh cases should be seen twice daily and the nursing staff instructed to observe the following conditions and report to the surgeon if in any doubt.

(*a*) *Swelling.*—After a fracture there is generally swelling of the part due to traumatic œdema. Before the cast is applied this œdema should be dispersed by pressure and massage at the time of reduction. Careful watch must be kept for any increase of swelling of toes or fingers. This swelling can generally be anticipated and prevented by suspension of the limb, which should be part of the routine.

The lower extremity may be elevated on a Braun's splint and the upper extremity suspended by bandages from a frame or elevated on pillows. If swelling occurs in spite of elevation, the cast must be split.

(*b*) *Colour.*—The colour of the fingers and toes should be normal. A moderate bluish tinge may occur, but definite cyanosis demands immediate relief by splitting the cast.

(*c*) *Pain.*—After accurate reduction of a fracture and careful application of a plaster cast, there should not be marked pain. Morphia should not be given. Aspirin and bromide should be sufficient to induce sleep. Marked pain usually means interference with the circulation, and if present must be relieved by splitting the cast.

(*d*) *Mobility.*—Unless there is a nerve lesion, the fingers or toes should be able to be moved as much as the cast allows. Signs of paralysis require immediate splitting of the cast.

(*e*) *Sensation.*—Skin sensation in the absence of a nerve lesion should be normal.

These five points, swelling, colour, pain, mobility and skin sensation, should be considered as a whole. With added experience more correct estimation of their value comes. If there is any doubt, the cast should be split or even removed altogether. Routine elevation of the limb and splitting the cast are the safeguards.

It will be found necessary to split the cast more often in the case of the lower than the upper extremity.

A Few Points in the Application of Standard Casts to the Upper Extremity and the Leg.

(1) *Upper Extremity.*—To immobilize a fracture of one or both bones of the forearm, the cast must include the elbow and wrist joints. Proximally the cast should reach to the upper third of the arm.

At the flexed elbow the slab on the extensor surface should be cut one-third of its width on both sides and the edges folded over to avoid folds and wrinkles. The elbow flexure should be reinforced or the cast will crack. For this the posterior slab should be made rather longer than is necessary and two strips about three inches wide cut from the end of the slab. These are dipped again into water and applied to the slab obliquely at each side of the elbow joint, being finally covered in by the circular bandages. Distally, the slab on the extensor surface should reach to the knuckles. It is very important that the plaster on the palmar surface should not limit flexion of the thumb and fingers.

The first metacarpal should be left uncovered by plaster, except in the case of a Bennett's fracture, so that extension and abduction of the thumb can be carried out. On the ulnar side the metacarpo-phalangeal joint of the little finger must be free so that complete flexion of the joint is possible. The space between the thumb and index finger is padded with gauze to prevent pressure.

(2) *Leg Plaster* (below the knee).—Proximally, the upper margin of the cast should reach to a line from the top of the tubercle of the tibia obliquely to the back of the knee so that the calf muscles are covered and do not bulge over the edge of the cast, and yet flexion at the knee-joint is not limited. Distally, on the plantar surface the plaster should reach just beyond the extremities of the toes so that flexion deformities may not occur. On the dorsal surface the cast should extend to the clefts of the toes, without preventing extension. If the cast is too short here, marginal œdema will occur—if too long, atrophy of the muscles to the toes will develop.

In most recent fractures of the leg above the ankle it is advisable to split the plaster immediately after application. This is certainly necessary in all cases where swelling is present when the plaster has been applied.

If it is necessary to split the cast, this should be done in a line lateral to the tibial crest to prevent painful pressure by the cast cutters on the tender subcutaneous surface of the shaft.

In these very brief notes some of the elementary principles in the application of casts are described. For further details of plaster work those interested are recommended the following publications: "The Treatment of Fractures," by Lorenz Bohler, and "The Technique of the Non-padded Plaster Cast," by Fritz Schnek. From both of these books subject matter for this article has been freely taken and acknowledgment is made.

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"DOWNWARD DISPLACEMENT" DISINFECTION.

By Major H. A. SANDIFORD, M.C., M.B.,

Royal Army Medical Corps.

PART I.

The experiments recorded below were carried out in connexion with the design of a disinfector for a field hygiene section. The disinfector was required to have an output sufficient to cope with the needs of a field disinfestation centre, and at the same time was to be capable of carriage on a thirty-hundredweight or three-ton lorry—preferably the former.

In order to secure lightness and simplicity of apparatus it was decided to take advantage of the principle of "downward displacement of air by steam," and to make use of the method of generating steam and of constructing the disinfector box as are employed in the Thompson Mule Pack Disinfector.

Colonel H. H. A. Emerson, D.S.O. (now Director of Hygiene), when Commandant, Army School of Hygiene, had constructed an enlarged mule pack disinfector. The source of heat was waste oil used with water on a flash pan. The boiler was a forty-gallon tar barrel surrounded by a metal hood, and the disinfecting chamber was a box containing a steam-tight galvanized iron liner, lagged by layers of old blanket and surrounded by five-ply wood. The box was mounted on a stand so that it could be swivelled and inverted like a milk churn. The pipe conveying steam from the boiler to the chamber was a flexible copper hose as used in the Harold Drum Disinfector. The source of heat, waste oil on a flash pan, was found unsuitable for use on a lorry, and was replaced by a Rutherford patent oil burner, in which steam under pressure is used to vaporize oil (any clean oil), which when ignited throws a luminous horizontal flame of about four feet in length.

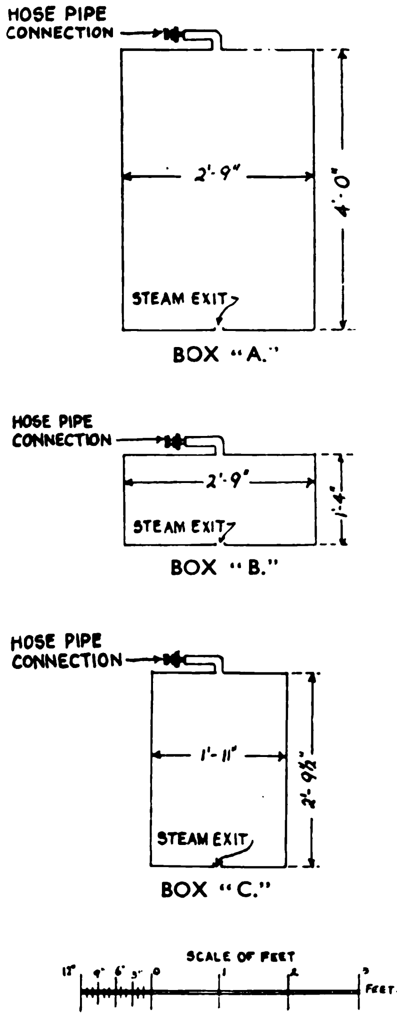
In the course of preliminary experiments, during which the working of this "enlarged mule pack" disinfector was tested, both for success of disinfection and output per hour, it became clear that successful disinfection was always obtained, but that the output varied from time to time. A further series of experiments was therefore undertaken to determine what factors influence the output of a "downward displacement" disinfector.

Any conclusions arrived at were intended to assist in the solution of the original problem (i.e. a disinfector for field hygiene section), but since it is thought these conclusions will interest anyone who may be faced with the task of improvising a disinfector in the field, permission has been obtained to publish the account of these latter experiments.

Apparatus used for the Experiments.

(*a*) *Boxes A, B, and C.*—In addition to the large disinfecting chamber used in the preliminary experiments and referred to above, two further boxes of similar construction were made, so that three well-insulated boxes

FIGURE 1.



were available for the experiments. These are referred to throughout as Boxes A, B, and C, and their internal measurements were as follows :—

Box A.—48 by 33 by 33 inches ; 30·25 cubic feet ; 8,414 square inches internal surface area.

Box B.—16 by 33 by 33 inches ; 10·1 cubic feet ; 4,280 square inches internal surface area.

Box C.—33·5 by 23 by 23 inches; 10·2 cubic feet; 4,140 square inches internal surface area.

It will be noted that Boxes B and C were each one-third volume of Box A; that Box B was one-third the depth of Box A, but had the same area in cross section; that Box C was constructed in the same proportions as Box A in regard to height and breadth.

The three boxes were similarly constructed and lagged, and steam was admitted at the top of each box through a one inch-pipe fitted with the male half of a quick release hose union coupling. The boxes are shown in fig. 1.

(*b*) *Boiler.*—The boiler used for the experiments was a forty-gallon tar barrel which had been fitted with a steam pipe and a filling pipe; a metal hood surrounds the boiler, serving to direct the hot gases over the boiler, and also to prevent heat loss by radiation. The boiler was charged with thirty gallons of water for each experiment and the temperature of the feed water noted.

(*c*) *Steam Pipe and Connexions.*—The steam pipe of the boiler was connected by a screw collar to one end of a flexible metal hose which was used for the passage of steam from the boiler to the box; the other end of the hose was fitted with the female half of a quick release union coupling, and a slight push was sufficient to join the two halves of the coupling when connecting the metal hose to the inlet pipe of the box in use.

(*d*) *Source of Heat.*—The source of heat was a Rutherford oil burner consuming eight to ten pints of oil per hour; paraffin oil was the fuel used throughout the experiments.

Method of Carrying out an Experiment.

Reference to the log of one of the experiments (e.g. No. 7, Appendix I) will assist the following description:—

The boiler was charged with thirty gallons of water and the burner charged with fuel, the quantity used being noted. The burner was then lit and the time taken to boil the water recorded. Steam having been raised, the flexible metal hose was coupled to a box containing a prearranged number of general service blankets and steam passed into the box; a note of the time of coupling was taken. Steam commenced to issue from the bottom of the box after a variable period, at first in wisps, but increasing rapidly in amount until it flowed freely from around the lid and through a hole in the centre of the lid. The point of time at which the steam issued in maximum volume was recorded, and a simple subtraction gave the number of minutes required to penetrate the box load of blankets.

Boxes were successively steamed as noted in the log of the experiments, and at the end of each experiment the water remaining in the boiler and fuel remains were measured and recorded.

Calculation of Boiler Efficiency.

In ascertaining the boiler efficiency the total heat units in the fuel consumed were first calculated, by multiplying the calorific value of the fuel per pound (19,000 B.Th.Us.) by the total weight of the fuel used (1 pint paraffin = 1 pound). The total heat units given out by the boiler were next calculated; these are the sum of

(*a*) The heat units required to raise 30 gallons water from the temperature at which it was introduced into the boiler to boiling point, and

(*b*) The heat units required to evaporate the quantity of water evaporated at 212° F. and atmospheric pressure.

The boiler efficiency is then expressed as a percentage as follows:—

$$\text{B.E. \%} = \frac{\text{Heat units given out by boiler} \times 100}{\text{Total heat units in fuel used.}}$$

Example.—Experiment No. 3.

A. Oil consumed = 34 pints or pounds = 34 × 19,000 B.Th.Us.
= 646,000 B.Th.Us.

B. Total heat units given by boiler:—

(*a*) in raising 300 pounds water from 50° F. to 212° F.

= 300 × (180 + 32 − 50) B.Th.Us.
= 48,600 B.Th.Us.

(*b*) in evaporating 180 pounds water from and at 212° F.
(970 B.Th.Us. = latent heat of one pound steam at 212° F.)

= 180 × 970 B.Th.Us.
= 176,600 B.Th.Us.
a + *b* = 223,200 B.Th.Us.

C. Boiler efficiency % $= \frac{223,200 \times 100}{646,000} = 34 \cdot 6$ %.

Penetration Time per Blanket in Seconds.

This figure is arrived at by dividing the time taken for steam to pass through a box by the number of blankets contained in the box.

Example.—Experiment No. 1.

10.30. Steam turned into Box A (69 blankets).
11.08. Steam issuing in full volume (38 minutes).

Penetration time $= \frac{38 \times 60}{69} = 33 \cdot 0$ seconds per blanket.

The output of a downward displacement disinfector is related to the penetration time per blanket. Any circumstance which decreases penetration time increases the output over a given period and vice versa.

Volume per Blanket in Cubic Feet.

This is arrived at by dividing the cubic capacity of a box by the number of blankets it contains; it is essential, of course, that blankets be evenly packed on each occasion so as to occupy the box fully. The volume per blanket is a convenient method of expressing tightness of packing—the more tightly packed a box the less the volume per blanket in cubic feet.

Internal Surface Area of Box per Blanket in Square Inches.

This figure is obtained by dividing the internal surface area of a box (in square inches) by the number of blankets contained in the box. Heat is absorbed by the walls of a box during disinfection, and the greater the wall area in relation to box contents the greater would be the relative heat

Table I.

Experiment	Box in use	Penetration time per blanket in seconds	Volume per blanket in cubic feet	Surface area of box per blanket in sq. inches	Number of blankets in box	Boiler efficiency %	Evaporation per hour of water F. & A. 212°F. in lb.	Oil consumed per hour in lb.
1.	A	33·0	0·45	122	69	24·2	52·6	9·75
	B	36·5	0·45	186	23			
	A	46·6	0·38	104	81			
	B	53·3	0·38	159	27			
2.	A	63·1	0·53	148	57	29·5	31·1	5·8
	B	69·5	0·53	225	19			
	A	69·6	0·45	122	69			
	B	70·4	0·45	186	23			
3.	A	47·8	0·45	122	69	34·6	51·4	7·6
	B	47·0	0·45	186	23			
	A	42·4	0·59	165	51			
	B	53·0	0·59	252	17			
	A	47·0	0·45	122	69			
	B	47·0	0·45	186	23			
4.	A	33·0	0·45	122	69	34·3	58·0	8·7
	B	36·5	0·45	186	23			
	C	33·9	0·45	180	23			
	A	38·8	0·59	165	51			
	B	38·8	0·59	252	17			
	C	38·8	0·60	244	17			
	A	37·4	0·45	122	69			
	B	41·7	0·45	186	23			
	C	39·1	0·45	180	23			
5.	B	40·7	0·36	153	28	32·1	60·0	9·2
	C	42·4	0·60	244	17			
	B	45·9	0·59	252	17			
	C	34·3	0·36	148	28			
	B	38·6	0·36	153	28			
	C	38·8	0·60	244	17			
6.	C	31·1	0·38	153	27	37·2	73·3	10·1
	A	30·4	0·38	104	81			
	C	31·1	0·38	153	27			
	B	29·0	0·38	159	27			
7.	C	23·5	0·45	180	23	38·8	71·3	9·2
	A	26·0	0·38	104	81			
	C	23·5	0·45	180	23			
	A	22·3	0·59	165	51			
	C	23·5	0·45	180	23			
	B	29·0	0·38	159	27			
	C	23·5	0·45	180	23			
	A	26·0	0·36	100	84			
	C	26·6	0·38	153	27			
	C	31·6	0·53	218	19			

loss. The boxes used in the experiments were equally and similarly lagged as far as possible.

Evaporation of Water in Pounds per Hour from and at 212° F.

This figure, which represents the boiler output, is obtained by dividing the total weight (in pounds) of water evaporated during an experiment by the number of hours that the water boils. The water, having been brought to boiling point, is evaporated from a temperature of 212° F., and the boiler being of a non-pressure variety the steam is at 212° F.

Analysis of Experimental Results.

The log of two experiments (Nos. 3 and 7) is given in Appendix I, as examples. From the log of each experiment the following have been calculated :—

Penetration time per blanket in seconds.
Volume per blanket in cubic feet.
Surface area of box per blanket, in square inches.
Boiler efficiency percentage.
Evaporation of water per hour in pounds, from and at 212° F.

The results, in full, are arranged in Table I, data from which are used in compiling other tables in the report.

A.—Boiler Output.

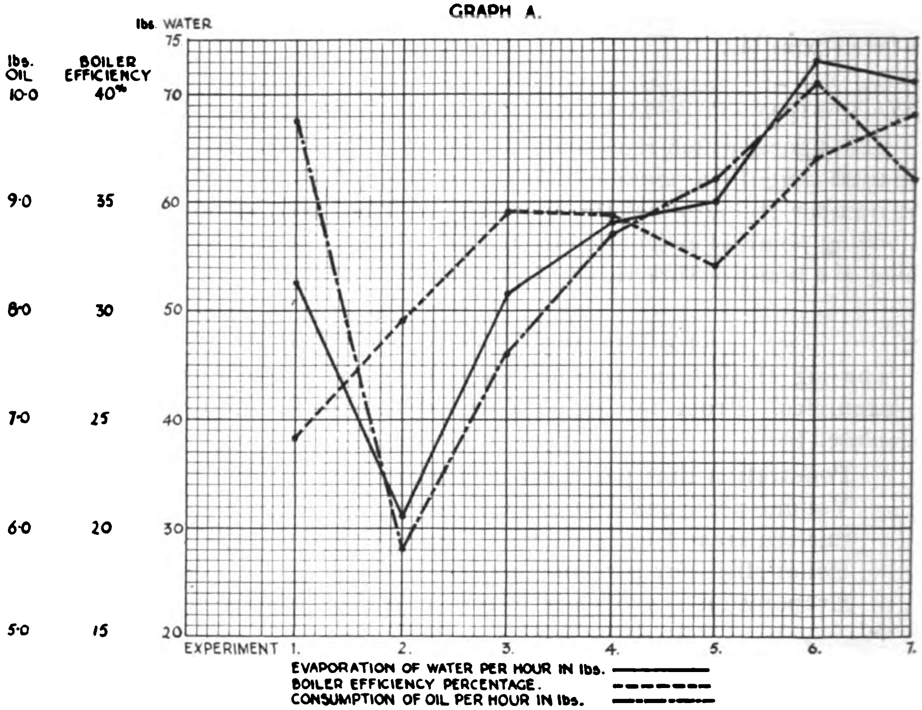
The relations between the amounts of water evaporated, boiler efficiency and oil consumption are shown in Graph A, which has been constructed from the data given in Table I. This shows that the amount of water evaporated does not depend entirely on either boiler efficiency or oil consumption.

As is to be expected, when the boiler efficiency and oil consumption rise together, the evaporation of water increases. It is also seen in Experiments Nos. 1, 5 and 6 that an increased oil consumption compensates, or masks, a diminished boiler efficiency. Increasing oil consumption with diminishing boiler efficiency is, however, uneconomical, and, when the burner is consuming the maximum amount of oil for which it is constructed, diminishing boiler efficiency can no longer be masked. The effect of thoroughly cleansing the burner after Experiment No. 2 is well shown.

It is obvious that, unless oil consumption is sufficient, the highest boiler efficiency may be ineffective, i.e. a burner of suitable size is required for every boiler.

The amount of water evaporated depends on the combination of the two factors, oil consumption and boiler efficiency, and this is illustrated in Graph B, in which water evaporated is plotted against the product obtained by multiplying the oil consumption (in pounds per hour) by boiler efficiency.

GRAPH A.



GRAPH B.

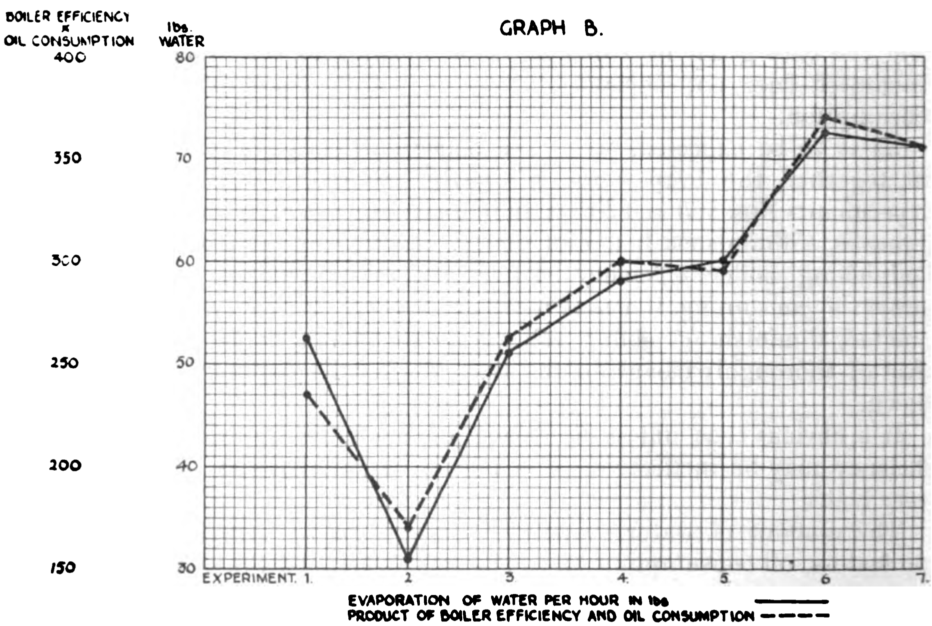


TABLE II.

Number of blankets	Volume per blanket in cubic feet	Surface area of box per blanket in sq. inches	Experiment No.	Penetration time per blanket in seconds	Average of penetration times	Evaporation per hour of water F. & A. 212°F. in lb.	"XY"	Average of "XYs"
					"X"	"Y"		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Box A.				
69	0·45	122	2 3 3 1 4 4	69·6 47·8 47·0 33 0 33·0 37·4	69·6 47·4 33·0 35·2	31·1 51·4 52·6 58·0	2,165 2,436 1,739 2,042	2,095
81	0·38	104	1 7 6	46·6 26·0 30·4	46·6 26·0 30·4	52·6 71·3 73·3	2,451 1,854 2,228	2,178
51	0·59	165	3 4 7	42·4 38·8 22·3	42·4 38·8 22·3	51·4 58·0 71·3	2,689 2,250 1,590	2,176
				Box B.				
23	0·45	186	2 3 3 1 4 4	70·4 47·0 47·0 36 5 36·5 41·7	70·4 47·0 36·5 39·1	31·1 51·4 52·6 58·0	2,189 2,415 1,920 2,268	2,198
27	0·38	159	1 7 6	53·3 29·0 29·0	53·3 29·0 29·0	52·6 71·3 73·3	2,804 2,068 2,126	2,333
17	0·59	252	3 4 5	53·0 38·8 45·9	53·0 38·8 45·9	51·4 58·0 60·0	2,724 2,250 2,754	2,576
				Box C.				
23	0·45	180	4 4 7 7 7 7	33·9 39·1 23·5 23·5 23·5 23·5	36·5 23·5	58·0 71·3	2,117 1,676	1,896
27	0·38	153	7 6 6	26·6 31·1 31·1	26·6 31·1	71·3 73·3	1,897 2,280	2,088
17	0·60	244	4 5 5	38·8 42·4 38·8	38·8 40·6	58·0 60 0	2,250 2,436	2,343

B.—Penetration Time per Blanket in Seconds.

There are several factors operative during the experiments which may have affected the penetration time per blanket and would therefore influence the output of a disinfector. These factors are the boiler output, i.e. the rate of water evaporation per hour, the size and shape of boxes and tightness of packing, and in order to evaluate the influence of these factors the preceding tables have been constructed.

Table II contains the data of Table I, rearranged by boxes, A, B, and C, instead of by the numbers of experiments as in Table I.

The observations made with blankets occupying volumes of 0·53 and 0·36 cubic foot have been omitted from Table II, as their numbers are so small as to be statistically valueless.

It has been possible to average some of the penetration times recorded in column 5 of Table II, and therefore column 6 has been inserted to show the average penetration times per blanket, and this column is also denoted by "X."

Column 7, denoted by "Y," shows the rates of water evaporation which obtained when the various penetration times were recorded.

Column 8, denoted by "XY," is the product of the figures in columns 6 and 7, to the nearest integer.

Column 9 shows the averages obtained from the various values of "XY," as indicated by the brackets.

The first point for consideration is the effect of the amount of water evaporated per hour on the penetration time of a blanket, and for this purpose we may, as a preliminary, examine the results obtained in one box with blankets occupying the same volume on each occasion. For example, the results obtained in Box B with blankets packed at 0·45 cubic foot, extracted from Table II, are as follows :—

Experiment	Penetration time per blanket in seconds	Average penetration times	Evaporation per hour of water F. & A. 212° F. in lb.	"XY"	Average of "XY"
		"X"	"Y"		
2	70·4	70·4	31·1	2,189	
3	47·0	47·0	51·4	2,415	2,198
1	47·0		51·4	2,415	
1	36·5	36·5	52·6	1,920	
4	36·5	39·1	58·0	2,268	
4	41·7		58·0	2,268	

The relationship between the above average penetration times and rates of water evaporation is shown in Graph C.

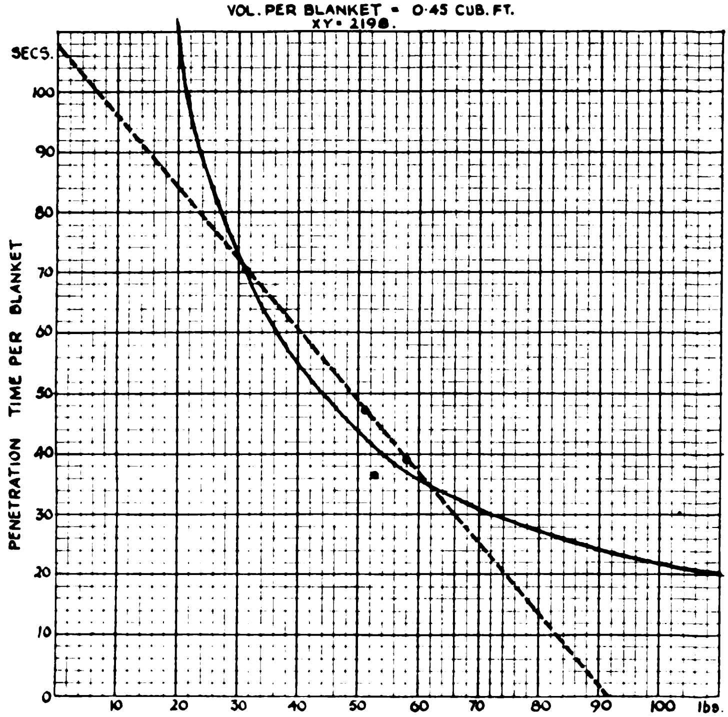
It will be noticed that three of the points lie in a straight line, and it might be presumed, therefore, that a straight line should unite these points. That this is not so, is shown by the following considerations :—

Suppose the points lie along a straight line (shown dotted in the graph)

then prolongation of the straight line will ultimately cut the horizontal and vertical axes of the graph as shown. Where the straight line cuts the horizontal axis it is implied that, given a sufficient evaporation of water, the blanket will be penetrated in 0 second—this is manifestly impossible.

Similarly, where the straight line cuts the vertical axis, it is implied that, given a sufficiently long period of time, the blanket will be penetrated by 0 pound of steam—again impossible.

GRAPH C.
BOX B.
VOL. PER BLANKET = 0·45 CUB. FT.
XY = 2198.



It is apparent, therefore, that the ends of the line should be joined by a curve which, however closely it approaches them, never touches either of the two axes, and along this curve should lie the points of the graph, or allowing for experimental errors, in close proximity to it.

Such a curve is shown in Graph C, and this curve is a rectangular hyperbola which is the graph of the equation $xy = c$, where "x" and "y" are the co-ordinates of any point on the curve, and "c" is a constant under the conditions of the particular experiment. To obtain the value of the constant on which the rectangular hyperbola in Graph C is based, the products of x multiplied by y, obtained in the various experiments, have been averaged as shown in the "average of 'XY' column." Graph C is based, therefore, on a constant of 2198. It must be noted that the constant

so obtained is only an approximation to the truth, as errors of observation, paucity of observations and statistical errors tend to invalidate to some extent the statistical accuracy of this constant.

Graph C shows, in so far as Box B with blankets packed at 0·45 cubic foot each is concerned, that the penetration time per blanket varies inversely as the amount of water evaporated, i.e. doubling the latter halves the former.

Other constants, obtained in a similar manner to that of Graph C, have been calculated, and are shown in column 9 of Table II.

Table III.—Showing *calculated* Penetration Times Corresponding to Varying Values of XY.

Evaporation of water per hour in lb.	Calculated penetration times per blanket in seconds.								
(1)	(2) XY = 1,896	(3) XY = 2,088	(4) XY = 2,095	(5) XY = 2,176	(6) XY = 2,178	(7) XY = 2,198	(8) XY = 2,333	(9) XY = 2,343	(10) XY = 2,576
5	379·2	417·6	419·0	435·2	435·6	439·6	466·4	468·6	515·2
10	189·6	208·8	209·5	217·6	217·8	219·8	233·2	234·3	257·6
20	94·8	104·4	104·7	108·8	108·9	109·9	116·6	117·1	128·8
30	63·2	69·6	69·8	72·5	72·6	73·3	77·7	78·1	85·9
40	47·4	52·2	52·4	54·4	54·4	54·9	58·3	58·5	64·4
50	37·9	41·8	41·9	43·5	43·6	43·9	46·7	46·9	51·5
60	31·6	34·8	34·9	36·3	36·3	36·6	38·8	39·0	42·9
70	27·1	29·8	29·9	31·1	31·1	31·4	33·3	33·4	36·8
80	23·7	26·1	26·2	27·2	27·2	27·5	29·1	29·2	32·2
90	21·1	23·2	23·3	24·2	24·2	24·4	25·9	26·0	28·6
100	19·0	20·9	20·9	21·8	21·8	22·0	23·3	23·4	25·8
120	15·8	17·4	17·5	18·1	18·1	18·3	19·4	19·5	21·5
150	12·6	13·9	14·0	14·5	14·5	14·7	15·5	15·6	17·2
Box	C	C	A	A	A	B	B	C	B
Vol. per blanket in cubic feet	0·45	0·38	0·45	0·59	0·38	0·45	0·38	0·60	0·59
Surface area of box per blanket in sq. inches	180	153	122	165	104	186	159	244	252

In Table III the constants, from column 9 of Table II, have been divided by standard rates of water evaporation, from 5 to 150 pounds per hour.

The calculated penetration times, so obtained, are now in a form to permit of comparison, and are derived from constants, which themselves are based on the experimental observations made under the various conditions prevailing in Boxes A, B, and C.

(To be continued.)

MALARIA PREVENTION METHODS IN JAVA.

Report on the League of Nations Second (International) Course of Malariology, 1935.

By Major W. J. F. CRAIG,
Royal Army Medical Corps.

Introductory.

The delegates attending this part of the course were seven in number. We arrived at Batavia on June 1, where we were met by Dr. R. Soesilo, the Director of the Malaria Prevention Bureau, Java, and Dr. J. L. Hydrick, of the Rockefeller Foundation, adviser in Public Health matters to the Government of the Netherlands East Indies. All arrangements for travelling, hotels, etc., were made for us very well and economically by Dr. Soesilo.

The course was very comprehensive and went far beyond the subject of malariology. We were shown museums, medical schools and hospitals, plague laboratories, vitamin manufacturing methods, cancer research laboratories, ruined temples, and so on. This was probably done partly to seize the opportunity of showing the medical work being carried out in the island to medical visitors from other countries, and partly to avoid undue repetition when showing us malaria prevention work. As some of us were engaged in Public Health work in addition to anti-malaria work, this was no hardship, but for the purpose of this report it will hardly be necessary to describe in detail these brief visits to various public health institutions.

While in Batavia our first visit was to the office of the Director of the Public Health Service (Dienst der Volksgezondheid—referred to generally as D.V.G.)—and the organization of this Service in the Island Empire was explained.

I was interested to learn that in connexion with this Service much use was made of the Army medical officers stationed in the Dutch East Indies. This Service, like our Indian Medical Service, is a full-time Colonial Service, and Army medical officers are seconded to the Public Health Service for two or three years at a time, and in many cases these officers are transferred entirely to the D.V.G. Native medical officers, if trained in Europe, may rise to the highest positions in the Service.

The Malaria Division is highly centralized and has its headquarters and research laboratory in Batavia. The well-known names of Schüffner, Swellengrebel and the late Professor Walch figure in the list of its past Directors. The headquarters sends out expert malaria officers and trained teams to epidemic districts anywhere in the island when they are called

for, and the results are co-ordinated at the head office. This system is probably the most efficient method at present possible for dealing with malaria outbreaks in such a widespread tropical colony.

On the same day a visit was paid to the Ethnographical Museum of Batavia, a semi-official institution of high repute. Sir Stamford Raffles, when Governor of Java, played a large part in the development of this museum, and although he was an enemy of the nation at present ruling the island, his name is still honoured by it there, and a bust of him stands in the Director's room. I shall not describe the many treasures gathered there, but amongst other things we saw a partly finished and very large relief map of Java on which the Director was engaged, and it may be convenient here to recapitulate the main facts about the population, climate and natural features of the island, all of which were being well brought out in this section of the museum.

In Java, with an area of 48,000 square miles, there is a population of some 42,000,000. The density of population is greater than in any other country in the world, and in a number of areas in mid-Java the density of population amounts to over 700 per square kilometre (i.e. over 2,000 per square mile). In this connexion it is, moreover, important to observe that the population of Java is essentially a rural one, there being only some half-a-dozen towns with a six-figure population.

It is clear, therefore, that, with a rural population of such an extreme density in a highly endemic malarial country, the anti-malaria measures adopted will differ from those taken in a thinly populated country such as Malaya, and this we find pretty generally to be the case.

The outstanding physical features of the island are the presence of over 150 volcanoes, although most of these are not now active, and the series of wide and open plains running along the length of the island at altitudes of 2,000 feet and over. Owing to its volcanic nature the soil is wonderfully fertile, and the high, well-watered plains are available for rice growing, providing the food necessary for such a large population.

In the coastal plains the temperature is like that of Malaya and runs from 80° to 90° F., while in the upland plains it is proportionately cooler. The rainfall generally is about one hundred inches per annum. There are two monsoons, in direction the exact reverse of those in Singapore. From November to March, the north-west monsoon blows steadily and brings a copious rainfall with it, while a south-east monsoon blows from May to October; this is a much drier wind than the other; inter-monsoon periods are marked by heavy showers of rain and thunderstorms.

Racially, the Javanese are, of course, of Malaysian stock and are a docile, tolerant, industrious people, and unhampered by fettering traditional customs, points of great importance in furthering the teaching of rural hygiene by propaganda, which the D.V.G. is now commencing to carry out on a large scale throughout the country.

While in Batavia a number of visits were paid to various institutions,

such as the medical college, the civil hospital and the vitamin B manufacturing laboratory. These places were of no special interest except the laboratory; this is the one originally used by Eyckmann who was the first man to detect the fact that fowls fed on polished rice grains developed neuritis while those on unpolished rice grains remained healthy. The plant in the place is still that devised by Eyckmann and is somewhat crude but efficient. Here tablets with a high vitamin B content are turned out by the thousand and are distributed free to areas whenever an outbreak of beri-beri occurs. This disease is common on the island and it is by this means that it is combated.

We next met together in Dr. Soesilo's own office, the headquarters of the Malaria Prevention Bureau, where he outlined the methods employed by his sub-department. Afterwards we visited various fish-ponds, villages, etc., in the neighbourhood of Batavia.

The anopheline mosquitoes found in the Netherland Indies make a formidable list, numbering thirty-eight in all. The dangerous species are principally :—

(1) *Anopheles sundaicus* (formerly known as *A. ludlowi*) which haunts the salt water fish ponds and the coastal swamps; (2) *A. maculatus* which, as in Malaya, is found in the inland hill ravines and in the streams, in rubber and tea estates; (3) *A. aconitus* in the wet rice fields; and (4) *A. hyrcanus*, varieties *nigerrima* and *sinensis*, have been lately incriminated in outbreaks in rice-field areas in Sumatra and Java.

The methods employed in dealing with these particular species will be described later. Of the four enumerated, Nos. 1 and 3 are the most dangerous, while No. 4 is the least harmful.

In investigating the extent of the infection of malaria in the human population of a district much use is made of spleen examination of the most susceptible element in the population, viz., children under three years of age. This method is obviously a great saving of time in such a dense population; it is supplemented by blood examination as much as possible. For estimating the degree of enlargement of the spleen Schüffner's method is generally employed.

By this method a line (or imaginary line) is drawn along the left costal margin, and a second line parallel to the first is drawn through the umbilicus. A perpendicular is dropped from the left costal margin immediately below the nipple to the second line. The apex of an enlarged spleen roughly follows this line. This line divided into four gives four degrees of splenic enlargement. For grossly enlarged spleens a second perpendicular is dropped from the umbilicus and running parallel to the first across the lower right quadrant of the abdomen. By dividing this line into four degrees of gross splenic enlargement from five to eight can be readily ascertained, as the apex of the spleen in the course of progressive enlargement moves downwards towards the right. Enlarged spleens are numbered according to the section in which they are palpated (see fig. 1). By this

method the degree of enlargement recorded is proportionately the same for both children and adults.

According to the spleen rate as thus determined and the parasite rate in representative sections of the population, the malaria which occurs in a district is classified as follows :—

(1) *True Chronic Endemic Malaria.*—In this type the spleen rate is very high both in children and adults and the number of greatly enlarged spleens is also very high in both, while the parasite rate is relatively low, particularly in the case of adults.

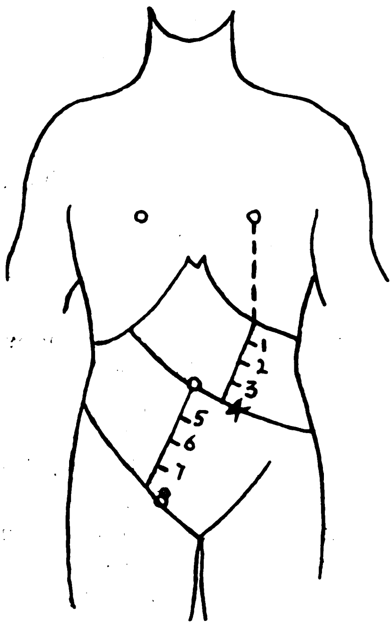


FIG. 1.—Schüffner's method of estimating degree of splenic enlargement.

(2) *Epidemic Superimposed on Chronic Endemic Malaria.*—In this type the spleen rate in both children and adults is again high although great enlargement of the spleen is less marked, while the parasite rate is considerably higher, particularly in the case of the children.

(3) *Acute Epidemic Malaria.*—Here the spleen rate is low in both cases and the degree of splenic enlargement very low, while the parasite rate in both cases is very high.

The degree of splenic enlargement found in an investigation, a point which is somewhat stressed in the above classification, is also used in determining whether an anti-malaria campaign in a district has been efficacious to any extent or not. It happens sometimes that a district has a high spleen rate ; then a campaign is instituted against malaria, and if after two years another investigation shows the spleen rate to be still high, it would appear that these particular methods have been of no avail. But

a careful examination may show that the number of greatly enlarged spleens was high in the first examination and low in the second, in which case a campaign may really have been successful to quite a degree.

The treatment of the civil population is, of course, still being carried out by the issue and administration of quinine tablets. Quinine is largely grown in the island and its manufacture is a Government monopoly. Tablets are issued free to districts where serious outbreaks occur. These tablets are coloured black to prevent their being sold illegally in the local market. Atebrin is on trial and though no official pronouncement on its value has yet been made, it is thought that it will prove to be probably a more valuable drug than quinine in the treatment of the disease, but it is not likely to replace the latter while its price remains at its present level.

ANTI-LARVA SANITATION.

The anti-larva measures employed in Java, as might be expected in a country which has been well cleared of jungle and which has a dense population, are for the most part on a large scale, and the elaborate sub-soil draining of small valleys as carried out in Malaya is not much in evidence here.

The two chief methods used are: The Engineering Method, and the Biological Control Method.

The Engineering Method, described by the late Professor Walch as "sanitation on a mechanical or hydraulic basis," is the method of choice for the coastal plain areas where river mouths get silted up and the stream is forced to deviate to the right or left and so brackish lagoons are formed which make ideal breeding grounds for *A. sundaicus.* At the larger river mouths there is usually a town and hitherto these sea-ports have suffered badly from malaria. The treatment by filling, draining, bunding, etc., is naturally expensive, but the Public Health Department is careful to obtain financial assistance from other departments in carrying out these schemes, and in this case the municipality concerned is only too willing to help and the Department of Roads and Waterways likewise gains in the end by giving financial assistance. The Chief Sanitary Engineer of the Health Department draws up the scheme in co-operation with other departments or bodies concerned. Such schemes are, of course, common to sea ports all over the tropical world and the expense is usually recovered later by the value of building sites formed on recovered land and, as in Java, by drawing rents from areas thereby made available for rice growing.

In Java the main problem to be dealt with in work of this nature is, as already mentioned, the silting up of the river mouths. Of the various methods used in dealing with this problem, the two which have proved most successful are the following:—

(1) A river which does not carry enough water to keep its mouth open is connected with a neighbouring, more powerful, river by digging a canal

parallel to the coast line. This is the best means of dealing with the problem if considerations of distance makes such a course feasible.

(2) In the case of a small river with a sea port at its mouth, the river is diverted towards the harbour channel, which in the interests of navigation has to be kept open by dredging.

In the case of large sea ports such as Batavia and Sourabaya the methods devised have been drawn up to meet the local conditions and these particular schemes would not necessarily be generally applicable excepting in so far as the salt water fish-breeding ponds there form part of the problem. This matter is being dealt with separately elsewhere in this paper.

The methods used in the sea ports of Tegal, on the north coast, and Tjilatjap, on the south coast of Java, will be briefly described. Both are

Fig 2.—Tjilatjap.—Low-lying creek filled and canalized.

small sea ports of under 50,000 inhabitants and in both cases the spleen rate dropped from over 80 per cent to under 20 per cent after the work had been carried out.

In Tegal the river, which was liable to silting up, was led into the harbour which was dredged, and piers were constructed at the original mouth. The dangerous lagoons near the river mouth were filled in and certain other in-lying areas drained and filled. The whole work cost 400,000 guilders.

In Tjilatjap the river runs for some distance into the town near to and parallel with the seashore. The left bank on the seaward side is banked by fairly high sand-dunes. Previously the right bank was often subject to overflowing and so a large area of land was merely a useless brackish water swamp lying close to the town on the north side. For a long distance this bank was bunded, and just about the northern boundary of the town a

canal was made, running into the bunded river more or less at right angles. At the entrance of this canal into the river a strong tidal gate was constructed and closed for some hours each day against the incoming tide. This gate is worked by a workman who has a hut on the spot. Into the canal run irrigation channels from rice fields fed by another stream flowing from the north into this low-lying area enclosed between bund and canal. As a result of this scheme a dangerous swamp has been converted into a prosperous, rice-growing district and the expense of the scheme is being rapidly recovered in the form of rents and rice-tax.

While in Tjilatjap we were shown another and smaller system to the west of the town, unconnected with the above system, which had been dealt with by canalizing and filling. This was a mere creek, but as the town had spread the mangrove in the mouth of it had been cleared and it had become infected with *A. sundaicus*, and the houses on both banks had a spleen-rate of over 90 per cent and a high mortality rate. The banks were raised about four feet and canalized, and the sides sloped to an angle of forty-five degrees and faced with roughly-squared stone blocks found locally, without being pointed with cement. This method of treating the sides of an artificial channel is not recommended in Malaya, but it is very commonly adopted in Java and seems to work well there. It has the advantage of being cheaper than facing with concrete slabs, if suitable stone is available nearby. Then the ground on both banks was filled up to the level of the banks of the central channel by sand and mud taken from the harbour by dredgers and deposited there by them through pipes. By these means this bad area has been freed almost entirely from malaria.

The Engineering Method in Inland Districts.

During the course of our tour we were given the opportunity of studying the working of this type of anti-larva sanitation when on a visit to the Tjihea Plain, a rice-growing district in the West Java Plateau lying about half way between Bandoeng and Buitenzorg at an elevation of about 1,000 feet.

The Tjihea Plain is a triangular area of land, about thirty square miles in extent, which lies between two rivers flowing north-west and north-east to their meeting place. The base of the triangle to the south is formed by the foothills of a mountain range. This area is part of the larger Tjiandjoer Plain, but up to the present only the sanitation of the Tjihea Plain has been completed. Three departments, viz. Health, Roads and Waterways, and Agriculture, combined in carrying out this project. On the original expenditure a return of 4½ per cent is being regularly obtained annually from a rice tax. The danger was the rice-field-loving *A. aconitus*, which thrives exceedingly in wet rice fields left lying fallow and neglected after the harvest.

The method adopted was to make a canal along the bottom of the slope of the foothills joining the two rivers, the difference of levels allowing this.

The canal is twenty-four kilometres in length and has a capacity of seven cubic metres per second. This forms the primary irrigation system. On the canal, at intervals, are sluice gates, and leading northward into the plain from these there are a number of fairly large earth channels which form the secondary system of irrigation. From these the farmers dig their own small irrigation channels for their rice fields, thus forming the tertiary irrigation system. The Department of Roads and Waterways controls the issue of water.

The scheme was completed in 1904 as an agricultural scheme at a cost of nearly a million florins; at first, what had been previously an unfertile plain produced rich and abundant crops, but as no provision had been made for the draining off of superfluous water, and the farmers were left to manage their irrigation themselves, the plain soon became water-logged, and malaria, which was not unknown before, became terribly severe; more and more of the malaria-stricken population deserted the plain and, as they left their fields neglected, malaria became worse and worse.

In 1920 onwards, therefore, the following measures were taken to improve this state of affairs :—

(1) The drainage system was improved to facilitate the leading away of the irrigation water to its natural outlets in the two river courses at the sides and to the north of the area.

(2) The sides and beds of the grassy irrigation ditches and rice field fishponds were frequently cleaned at regular intervals.

(3) Planting of rice was allowed only once a year by all the people at the same time. Thus during the dry season no breeding of *A. aconitus* occurs.

(4) The Government established a large experimental farm in the lowest lying area in the centre of the plain, on which the above measures were very strictly enforced, and this served as a model for the district. Here, although rice was only planted once a year, the yield increased from eighteen to thirty-three quintals per hectare.

As some hardship is being experienced owing to the farmers being allowed to grow only one crop of rice a year, further experiments are being carried out to allow of their combining fish-breeding with rice-growing in the rice fields during the dry season.

From the health point of view the results obtained by these methods have been excellent.

Biological Control Methods.

By these methods the forces of Nature are utilized as allies in the war against the anopheline mosquito. For instance, sunshine kills algæ which have been laid bare by draining off the water of ponds; plants with luxuriant foliage are used to shade streams in which the sunshine-loving larvæ of *A. maculatus* breed; larva-eating fish are put into ponds in which other fish are being bred for the food of the human population.

Naturally such methods are cheaper than expensive engineering schemes, and so, especially since the financial depression of 1929, it is these methods which anti-malaria experts in the Netherlands Indies are tending to develop more than others. But, even before this date, these methods were being forced on the consideration of the Health Authorities by the difficulty of dealing with anopheline larvæ in the very numerous fish-breeding ponds, both salt and fresh water, which provide so many people with a living.

The danger in such ponds is the brackish-water breeding *A. sundaicus*, formerly erroneously known as *A. ludlowi*, a mosquito dreaded as much in Malaya as in the Netherlands Indies for its malaria carrying propensities.

Fish-breeding ponds are very numerous all around the coast of Java, the total acreage in the island amounting to 1,300,000 acres. They are especially numerous around Batavia and Sourabaya where the market for fish is great. The ponds are irregular in shape but usually rectangular. The depth of water in them is only about three feet and they ultimately drain into the sea through sluice gates; but when managed by the farmers themselves this drainage is usually inadequate and inefficient, and where there is a main channel draining into the sea, there is usually no lock at the sea end.

A start was actually made to treat these fish-pond systems by engineering methods, but the cost of this was soon found to be prohibitive because not only did these depressions have to be filled with earth and a system of drainage put in over the filled areas, but the owners had also to be compensated. Thus it is easy to understand how the area of 3,500 acres just to the north of the old town of Batavia which has been so successfully treated by the biological control method at a cost of 5,600,000 guilders, would have cost 26,000,000 guilders if treated by engineering methods as estimated.

The problem of draining these ponds is more simple at Sourabaya where there is a 10 ft. tide than at Batavia where there is only a 3 ft. tide. The method employed in treating these places is the so-called Pasoerœan method, from the place of that name in East Java. Actually this method, which I am about to describe in a little detail, is a combination of biological control with the engineering method and I shall take these separately, starting with the former.

When untreated these ponds are almost filled with a greyish-green or blue scum of a floating surface algæ (Enteromorpha) which the farmers believe to be the food of the Bandeng, the fish which is bred for sale as food. This fish is a vegetarian and does not eat larvæ. Larva-eating fish such as the *Haplochilus panchax* are usually present in the ponds; but they cannot get at the larvæ, because their gills are caught in the filaments of the green algæ under which larvæ hide.

The Pasoerœan people found that the remedy for this state of affairs

was to feed the Bandeng on the blue "bottom algæ" (Cyanophyceæ) which remains at the bottom of the pond and forms together with diatoms a muddy cream, at first light brown and later blue. Patches of the algæ form a compact mass which cannot be penetrated by the larvæ. The alga is acceptable to the Bandeng whose true food, in fact, it forms.

To obtain the growth of the bottom algæ and prevent the growth of the surface algæ, the ponds have to be drained once a month for two or three days. During this time the sun's rays dry and kill the exposed surface algæ, leaving them as a light brown or white powder. When the pond is freed from the surface algæ, the pond is again drained periodically in order to promote the growth of the bottom algæ; only a little water is left on the bottom, as the earth has to remain humid for some time if a rich growth of the blue algæ is to be obtained. A ditch is dug around each pond into which the fish retire while the pond is empty.

The ponds are also stocked with Panchax, which are larva-eating fish, as well as Bandeng. If Panchax is not already present in the pond, the number of these fish put into the pond is at the rate of 115 per acre.

In brief, therefore, the principle of biological control used in these salt-water fishponds is as follows:—

(1) Bottom algæ which grow in compact masses are substituted for loosely floating surface algæ as food for the edible fish bred in these ponds.

(2) The ponds are stocked with larva-eating fish.

(3) If the surface algæ threaten to reappear they are destroyed by draining off the water in the pond and drying such algæ in the sun.

The engineering methods taken to supplement the biological control methods in Batavia are as follows:—

(1) All the fish ponds lying between the parallel lines of the drainage channels are made a regular rectangular shape. To allow of this being done it has been necessary to buy a certain number of the ponds. This the Government has done, and since the improvement these ponds bring a return of 2½ per cent per annum by being rented out.

(2) A certain amount of filling has been necessary for levelling purposes.

(3) A system of channels and sluice-gates has been made to enable a whole area to be drained dry at the time of the monthly spring tides. This system includes large concrete sluice-gates at the sea outlet of the main channel of the system which is level to the outlet. There are also openings at the mouths of the subsidiary channels, and each pond has a sluice-gate with two openings, each one metre wide.

The Treatment of Fresh Water Fish Ponds by Biological Control Methods.

The problem of dealing with these ponds, although essentially the same, differed in a number of respects. Treatment by filling and draining the areas was again impossible owing to the high cost and the necessity for compensation.

The most dangerous mosquito was *A. aconitus*, but a number of others, such as *A. barbirostus* and *A. philipinensis*, were also present.

The fish previously bred in these ponds were *Cyprinus carpio*, the large gold fish, and the gorami (*Osphromenus olfax*). These fish do not feed on the water plants naturally found growing in the ponds, but are fed by the pond owners with papaya leaves, rice waste, etc. Thus, the mosquito larvæ could hide amongst the leaves of the aquatic plants and so come to maturity unscathed. So, on the advice of Mr. Reyntjes, a fishery expert, a fish called the Tawes (*Punctius javanicus*), which incidentally makes good eating but which feeds voraciously on the submerged aquatic plants, was introduced into these ponds and where the fish are in sufficient numbers the vegetation in the ponds soon disappears completely.

The larva-eating Panchax now gets his chance and together with a fresh-water fish called the *Lesbistus reticulatus* feeds on the mosquito larvæ.

Thus the method of biological control used in this case is as follows:—

Three types of fish are stocked into the ponds: (1) The gorami and the goldfish are bred for the pot; (2) the Tawes feeds on the water plants; and (3) the Panchax and the *L. reticulatus* feed on the mosquito larvæ.

The method is as yet new, but it seems to be entirely successful.

The Shading of Streams by Plants as a Biological Control Method.

The method of planting the banks of small streams in hilly districts did not originate in Java as it was used first in Assam; but we were given the opportunity of seeing it put into practice in the course of a visit to the tea and rubber estate of Tjitalahab near Soekaboemi in West Java.

The purpose of this procedure is to prevent the breeding of the larvæ of *A. maculatus*, which breeds in the clear water of hill streams and needs sunshine for its development. In this estate, which employed a large number of coolies, thirteen kilometres of stream bed had been planted with the ordinary marigold (*Thitonia difersifolia*) and in these streams, where the larvæ of *A. maculatus*, which is our most dangerous carrier of malaria in Malaya, used to breed plentifully, they cannot now be found.

The cost of the treatment was stated by the manager of the estate to be 4 cents for twelve feet or only about 20 dollars a mile. This is a ridiculously low cost compared with the subsoil-drainage methods in Malaya and so the treatment seems entitled to serious consideration.

The procedure is exceedingly simple. Cuttings a few inches in length are taken from the growing marigold plants, care being taken to cut aslant, and these cuttings are simply pushed into the soft ground root-side downwards about one foot apart along the edge of the stream in one or several rows. In the course of twelve months they have grown to a height of six feet and their luxuriant foliage completely prevents the sunshine from reaching the stream.

The manager has also experimented with other plants for places where the valleys had broadened out and were swampy. Of these, two species of acacia, viz: *Cassia multijuga* and *C. alata* are the best, but as they are trees, sunshine can penetrate between the trunks and so they are not so good as the marigold which is only a shrub. The *C. alata*, which has very large leaves, is the better of the two.

This experiment, which was carried out almost entirely by the manager of the estate himself, was not supported by figures which might have afforded evidence of the value of the method, as the estate was isolated and was only visited by the Health Officer at intervals, but I think there is no reason to disbelieve the assurance that malaria is now very much less and larvæ are difficult to find.

The employment of this method in Malaya would seem to offer possibilities which should not be ignored, but as I was inclined to suspect, Dr. Scharff, the Chief Health Officer, has informed me that the marigold does not grow so luxuriantly in the soil of Malaya as it does in Java. But there is no reason why other plants should not be tried, for the banks of jungle streams in Malaya are covered with a vegetation which is very dense, and I am sure that botanical experts, if consulted on the subject, would not be lacking in suggestions.

The method is open to one objection which it was possible to recognize on the spot, and that is that the shade has to be broken wherever a path crosses the stream. This might be a serious objection, but in practice it seemed not to be so. It is perhaps not a method on which great reliance should be placed, but from an Army point of view I think it would be suitable for valleys in the neighbourhood of outlying posts, batteries, etc., which are occupied only once or twice a year, or which are only lightly manned.

Culture of Cinchona and the Manufacture of Quinine.

This practically completes the account of the course in Java dealing directly with the subject of malaria and its prevention. But as quite a number of days during the tour were devoted to the culture of cinchona trees a brief account of this work in the Netherland Indies is given.

While in Bandoeng we paid a visit to the Government quinine plantation at Tjinjiroean, a large estate about 5,000 feet up in the hills to the south of the Bandoeng Plain. Although there are 120 quinine estates in all, this is the only Government one, but here all the experimental and research work in connexion with the subject is carried out.

The most striking feature observed on this visit was the profitable use made of plant grafting. The two chief trees grown in order to obtain the quinine-containing bark are the succirubra and the ledgeriana. The former is a hardy tree, but its bark contains only about 2 per cent of quinine. The latter is a delicate tree with a bark containing up to 14 per

cent of quinine. So cuttings of young ledgeriana trees are grafted on to young succirubra trees just above the root, and after the graft has successfully taken, the remaining stem of the succirubra is cut off, and then we have the valuable but delicate ledgeriana tree growing on a succirubra root, and so remaining healthy in spite of temporary unsuitability of soil, or adverse weather conditions, etc. Another strong impression made was the work of the Javanese girls sorting out the seeds. As these seeds are sold on a guarantee that the bark of trees grown from them will contain so much quinine, great care must be taken in the sorting. To see flaws in the seeds an untrained person would almost require a microscope, but these sharp-eyed girls with a feather in their deft fingers pick out the good seeds unerringly on frosted glass slabs lit from beneath in the darkened room.

The stripping of the bark is carried out very simply by tapping lightly with a wooden hammer; the various processes used in preparing the bark for sending to the factory call for no special note.

The manufacture of quinine in its medicinal forms is carried out in a large factory at Bandoeng and this is entirely a Government monopoly. A visit was also paid to this place and we were most courteously shown the various processes employed in the manufacture of quinine by the Director and his staff.

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NOTE ON SOME EXPERIMENTS WITH SANDFLY FEVER BLOOD AND SERUM.[1]

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In a previous communication (Shortt, Poole and Stephens, 1934) we described the results of the inoculation of whole blood, blood diluted in various ways and filtrates of blood into man and animals. The results given here are in continuation of those previously described and, although the observations are few in number, they are considered worth placing on record, as the results of work with blood serum are to be added to those previously recorded.

Duration of Immunity in Sandfly Fever.

In our previous work (*loc. cit.*) we were able to induce typical attacks of sandfly fever in human volunteers by the inoculation of infective material in various forms. It was decided, therefore, to ascertain whether the individuals, in whom these attacks had been induced the previous year, showed any immunity after the lapse of about nine months. The question of the presence or absence of immunity after one attack has considerable importance from the military point of view. If it was shown that such an immunity lasted for about a year, it could be predicted that a unit "salted" during one sandfly fever season by a high incidence of infection, would show a low incidence next season. Such a unit would obviously be the one to use during the sandfly fever season in operations in an area where this disease might be expected to cause a high sick rate and so interfere with military operations.

To elucidate this point, three specimens of citrated blood taken from three typical cases of sandfly fever in an early stage of the disease were received in Kasauli from Peshawar.

Experiment.

Each of these three bloods was divided into two parts, one being inoculated into a volunteer giving no previous history of sandfly fever (new

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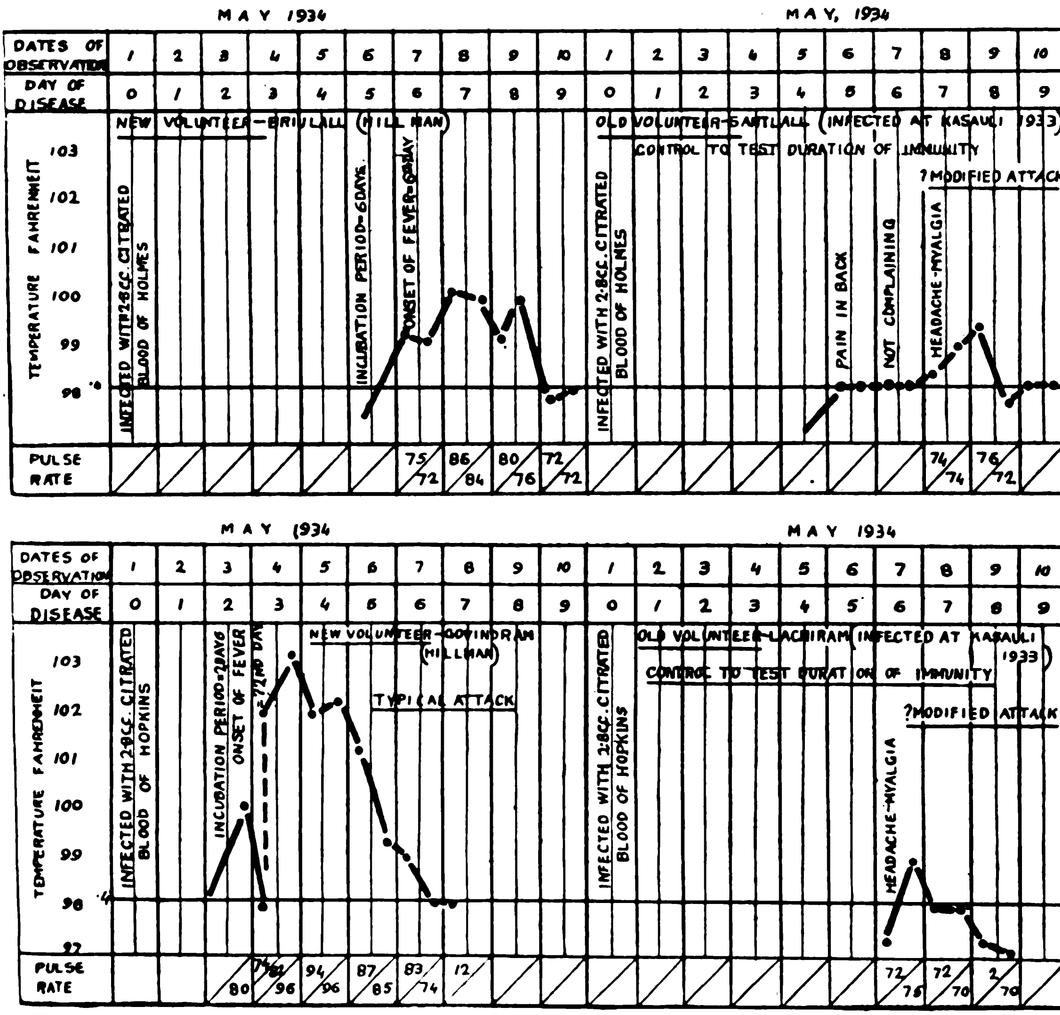
[1] Reprinted by permission from the *Ind. Jour. Med. Res.*, xxiii, July 1, 1935.

volunteer) and the other into one of the volunteers in whom sandfly fever had been experimentally induced the previous year (old volunteer). The results of this experiment are shown in Table I :—

TABLE I.—SHOWING THE RESULTS OF AN EXPERIMENT TO TEST THE DURATION OF IMMUNITY AFTER AN ATTACK OF SANDFLY FEVER.

Volunteers	Infecting dose	Sandfly fever		
		Typical attack	Modified attack	Failure
Old volunteers ..	2·8 c.c. of citrated blood from a sandfly fever case (3 cases in all)	—	2	1
New volunteers ..		2	—	1

CHART 1.



One or two points in the table are to be noted. Both the failures, i.e. one old and one new volunteer, were with the same sample of blood and there is, therefore, the possibility that it may have been avirulent. The two old volunteers who have been entered as having "modified" attacks had each a maximum temperature of about 99° F., accompanied by headache and pains in the limbs commencing six days after infection. The temperature charts of the four cases showing any fever are reproduced in Chart 1.

The results of this experiment would appear to show that, while an attack of sandfly fever in one season confers a certain degree of immunity, that immunity is not complete and at least a modified attack may occur the following season. It should, however, be borne in mind that these results apply only to experimental infections in which infective blood is inoculated. It may reasonably be supposed that the total amount of virus in such a comparatively large inoculum is likely to be greater than that inoculated by a sandfly and that these same volunteers might have escaped even a modified attack under natural conditions of infection.

THE VIRULENCE OF SANDFLY FEVER SERUM.

Our previous work having been performed with whole blood in various forms, we wished to test whether the serum, after separation, also remained infective. In order to determine this point, the serum of sandfly fever cases at Peshawar was separated and sent to Kasauli. In five cases the serum was liquid but in one case it was sent as a perfectly dry powder. Desiccation was brought about by freezing followed by drying *in vacuo* over sulphuric acid, the period occupied in desiccation being seventy-two hours. The desiccated product of one cubic centimetre of whole serum was dissolved in three cubic centimetres of normal saline solution and half the quantity inoculated subcutaneously into each of two volunteers. The results of the experiment with serum are given in Table II and the temperature charts in Chart 2.

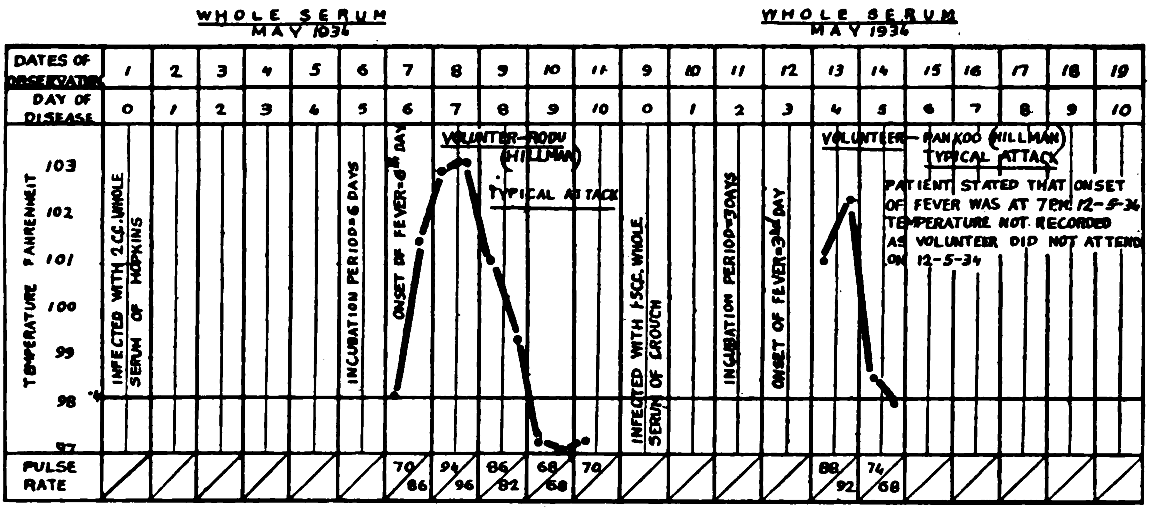
TABLE II.—SHOWING THE RESULTS OF INOCULATION WITH SANDFLY FEVER SERUM.

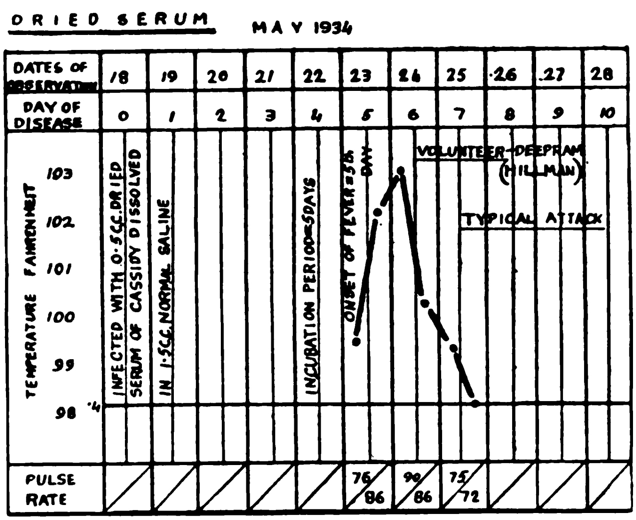
Nature of sandfly fever serum	Infecting dose	Number of volunteers	Sandfly fever		
			Typical attack	Modified attack	Failure
Whole serum ..	Varied from 1·5 c.c. to 3·5 c.c.	6	2	—	4
Dried serum ..	The dried product of 0·5 c.c. of whole serum in 1·5 c.c. of normal saline	2	1	—	1

In connection with this experiment certain points call for note. In the cases inoculated with whole serum, two of the failures occurred with sera

from blood which had already given positive results when inoculated as citrated whole blood. One of the two successes had also given a successful result positive when tested as citrated whole blood; the other had not been tested as whole blood.

CHART 2.





POSSIBLE APPLICATION OF THE INFECTIVITY OF SANDFLY FEVER SERUM TO PROTECTIVE INOCULATION.

Sandfly fever is so important a disease on the Indian North-Western Frontier from the military point of view that any means of preventing it or limiting its incidence should be thoroughly investigated. With this object in view, we performed one experiment to see if successful vaccination against the disease was possible. The failure of the experiment was due

to causes not under our control as, unfortunately, it was undertaken late in the sandfly fever season and could not be repeated owing to lack of further cases from which to obtain virulent serum. It is only mentioned here with the view to its possible repetition by others more favourably circumstanced.

The technique used was that evolved by Findlay for inoculation against yellow fever and the method is briefly detailed below.

Two volunteers were each given one cubic centimetre of convalescent immune serum intradermally, the serum being injected in several places on the circumference of a small circle on the abdominal wall. About two hours later, each volunteer was inoculated with the dried product of one cubic centimetre of whoie virulent serum, dissolved in two centimetres of normal saline, subcutaneously from one side of the circular area towards the centre. The serum used was dried serum which had previously been proved virulent. No fever or other unpleasant symptoms resulted.

Twenty-one days later, the two volunteers and two controls were each given two cubic centimetres of supposedly virulent serum. Unfortunately, the serum proved avirulent as the controls remained healthy. We consider that this experiment would be worth repetition, using either dried or whole serum in the preliminary immunization.

Summary and Conclusions.

(1) Cases which have contracted sandfly fever appear to possess some immunity at the time of the next sandfly fever season.

(2) The whole serum and the dried serum of sandfly fever cases are infective when inoculated into susceptible human volunteers.

(3) The possibility of evolving a means of protective inoculation against sandfly fever on the lines adopted in the case of yellow fever is worth investigation.

REFERENCE.

Shortt, H. E., Poole, L. T., and Stephens, E. D. (1934). *Ind. Journ. Med. Res.*, **21**, 755.

DESCRIPTION OF AN X-RAY COUCH, DESIGNED FOR USE ON FIELD SERVICE, INCORPORATING A NEW TYPE OF LOCALIZING DEVICE.[1]

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The task set was the designing of a suitable X-ray couch for use on Field Service, the main features being those of compactness, lightness, and the provision of a method of localizing foreign bodies that would be rapid and accurate, and at the same time simple to carry out.

There are, of course, very many methods of localization described—so many that to claim a method as original would probably be a mis-statement—the adage that "there is nothing new under the sun" is apt to be very true where radiology is concerned.

Having had the privilege, some years ago, of attending a course of lectures given by Dr. Thurstan Holland during which he described a method of localization used by him in France during the Great War, it was decided to adapt his method for this purpose.

Briefly, the method used by Dr. Thurstan Holland was as follows: The patient was laid on the X-ray table and a fluorescent screen placed flat over the part of the patient concerned. The screen was mounted in a wooden frame having a lead rubber surround for protection. Near one margin of the screen a small hole had been drilled in the glass which served the double purpose of being centred over the foreign body and of admitting the point of an indelible pencil to mark the patient's skin under which the foreign body lay. Fixed to the fluorescent screen was a metal scale and a sliding pointer to run along the scale.

The under-table tube being used, the tube having a known shift controlled by the foot, the following factors were constant, viz., the tube shift and the anticathode-table distance. The full factors required for localization, bearing in mind the formula:—

$$\frac{\text{Tube distance} \times \text{shadow shift}}{\text{Tube shift} + \text{shadow shift}}$$

were obtained in a most ingenious way. A tape measure was suspended from above, inverted and shortened by the already known tube-table distance, so that to get the correct tube-skin distance (referred to above in the formula as the tube distance) the tape measure had merely to be run down to touch the skin and the required measurement read off.

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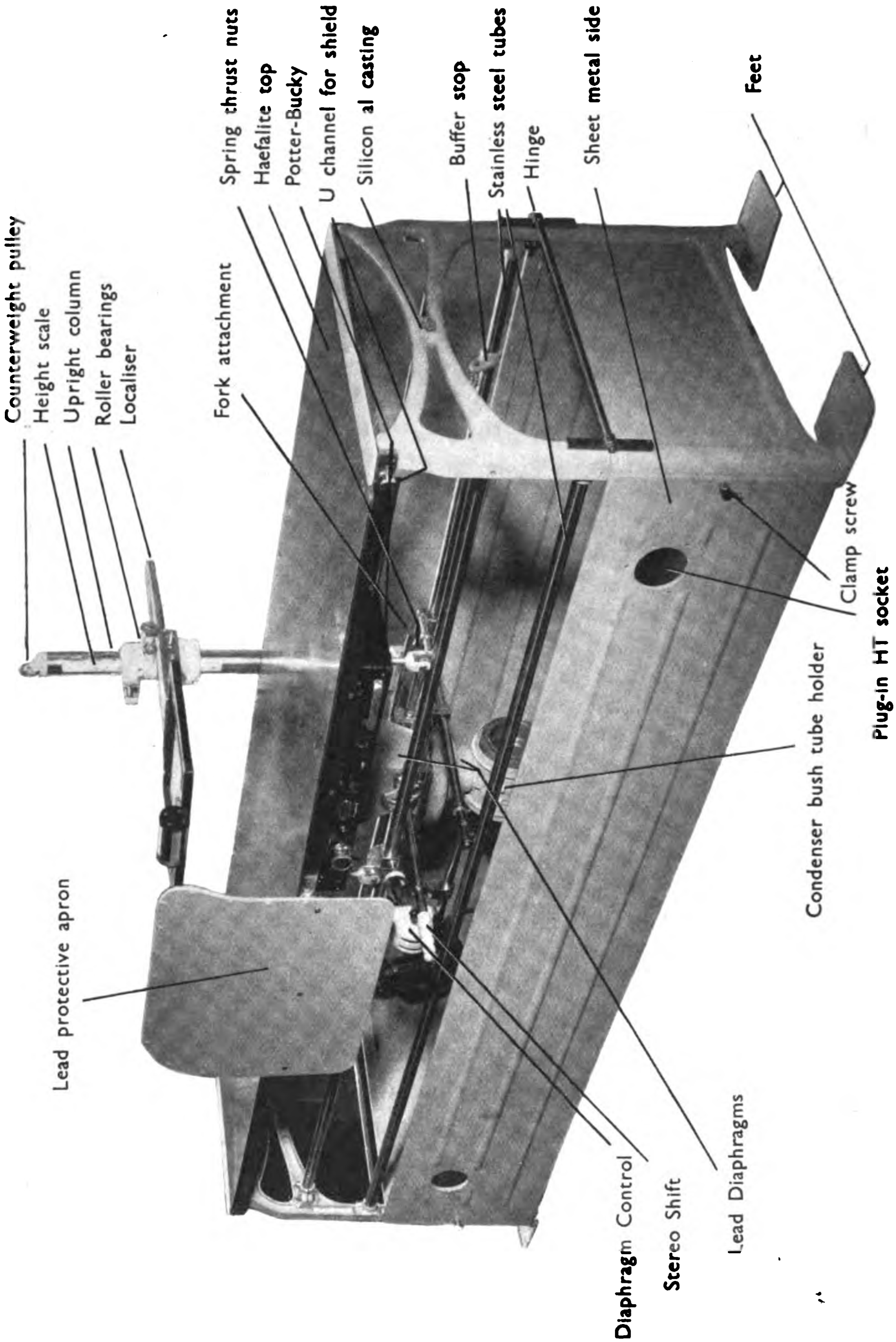
[1] Published with the permission of the Hon. Medical Editor, the *British Journal of Radiology*, vol. viii, October, 1935.



COUCH ERECTED

FIG. 1.

The shadow shift of the foreign body was obtained from the movable pointer on the screen, and with the required factors available, the depth distance of the foreign body was obtained from a carefully prepared chart hanging on the wall.

With all this spade work behind us of a method used in war with unqualified success, the simplification of the method was a relatively easy matter.

We may now turn to fig. 1, a view of the couch fully assembled. The fluorescent screen can be seen mounted on an upright stand which is calibrated in inches. Thus when the screen is brought in contact with the patient the distance from the skin to the table can be read off.

At the side of the screen nearest the operator, seen best in fig. 3, is a small metal drum containing parchment inscribed in red and black lines—the red representing five centimetres, and the black one centimetre—shown in a longitudinal slot.

The method of use is as follows: The tube is switched on and the foreign body is brought under the small circle marked on the screen (the glass being perforated in the centre of the circle) by adjusting the movable screen. The stereoscopic movement of the tube is made by turning the handle, marked in fig. 1 as "stereo shift." This gives the tube a range of movement of ten centimetres and is so constructed that on attaining its new position the tube locks, so obtaining the correct amount of shift. Should complete tube shift not be made, the tube slides back to its original position.

Having completed the tube shift, the shadow of the foreign body takes up a new position on the screen along the scribed line noted in fig. 3, and the sliding pointer is adjusted to bear on this new position. The next step is to read off the scale on the upright screen stand. Shall we say that the figure read off is 6? The milled right-hand edge of the drum is rotated until the figure 6 appears on the right-hand edge of the parchment and where the pointer on the drum, which can be seen to be part of the main pointer, reads off the depth of the foreign body by means of the red and black lines.

The method is easy to perform and can quite well be undertaken by a nursing sister or trained orderly.

I do not propose to go into a detailed description of the couch, but the following points are incorporated.

The couch is of robust design and can be rapidly folded up, *vide* fig. 2, in which the parts are seen loose, fitting inside, when correctly packed. Strong base plates are fitted to the legs, ensuring firm stance. The tube is held in a condenser bushing surmounted by a lead funnel to prevent undue X-ray scattering, and the diaphragm is controlled by simple lever movement. The tube under-carriage runs most smoothly along stainless steel rods, with dust-proof ball bearings.

The end castings are of silicon aluminium alloy, and the table top is

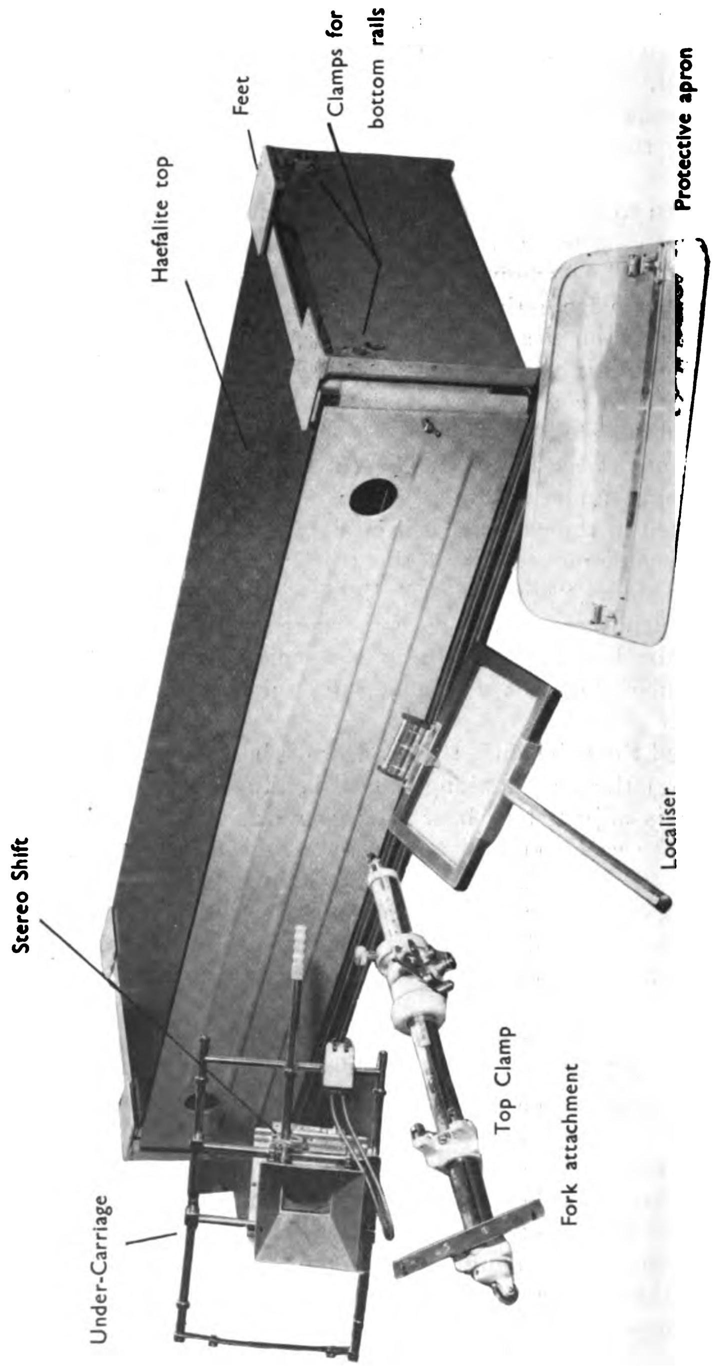
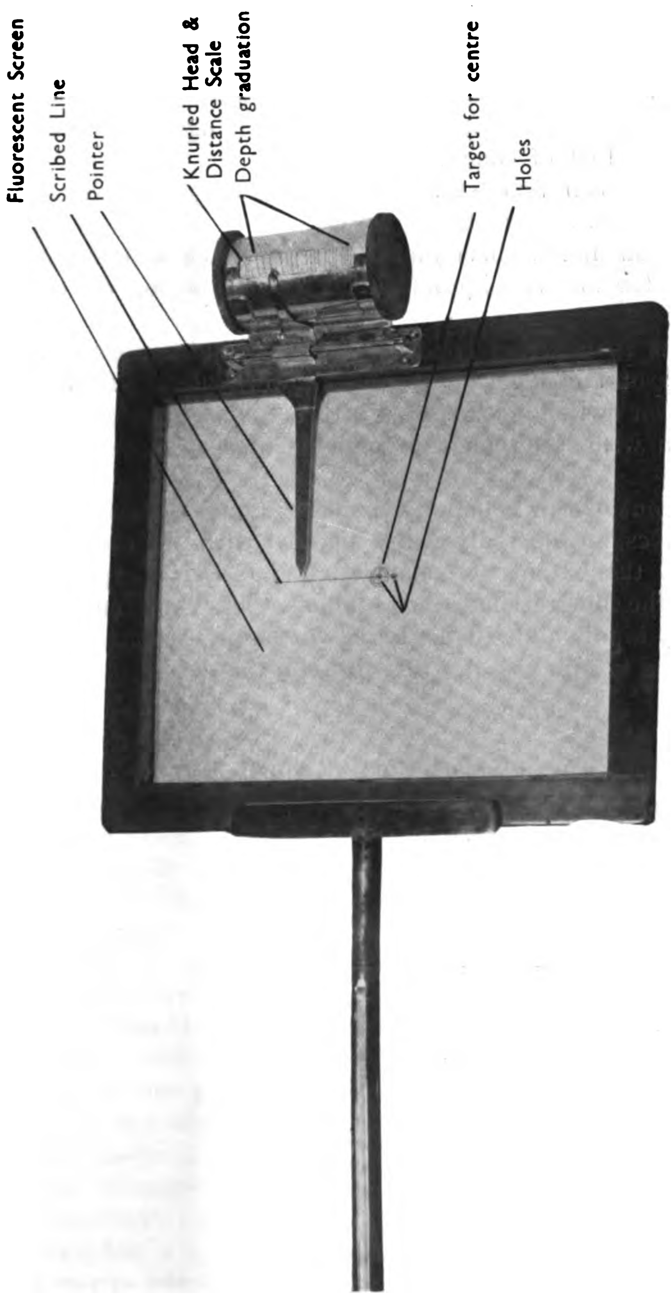


FIG. 2.

COUCH DISMANTLED



LOCALISER

FIG. 3.

constructed of "haefalite," which is a paper compounded and varnished under hydraulic pressure. The sheet metal sides of the couch serve to ensure complete rigidity, assist shockproofing and form the sides of the package when the table is being transported.

A Potter-Bucky diaphragm is incorporated, also a lead side shield for protection, 2·3 millimetres of lead in thickness, sliding in a U-shaped channel from head to foot of couch.

The fluorescent screen and stand can be quickly removed when necessary by being lifted bodily off the runners.

The two holes seen in the sheet metal sides of the couch are for the passage of the high-tension shockproof cables to the tube, via paxolin insulators.

The intention is to use this couch with a fifty milliampere shockproof mobile X-ray unit capable of over-couch work also. This X-ray unit has a change-over switch incorporated in the transformer and can be used in conjunction with the couch or can be used as a bedside unit at will.

In the working out of this couch my thanks are due to Messrs. Schall, who placed themselves unreservedly at my disposal with their advice and assistance—even to the extent of constructing a full-size experimental model, from which the illustrations were obtained. Dr. Thurstan Holland, may I add, has very kindly allowed me to use his name in connexion with this description—and to him also my very grateful thanks.

Editorial.

EXPERIMENTAL EPIDEMIOLOGY.

STUDIES on experimental epidemiology by Greenwood and Topley have been in progress for fifteen years and have involved the use of somewhere between 100,000 and 200,000 mice. The expenses of the investigations have been borne by the Medical Research Council and the results which have been obtained by Greenwood and Topley in conjunction with Bradford Hill and J. Wilson are now published.

In the earliest of the joint communications Topley and Greenwood outline briefly the reasons which seemed to justify their laborious and relatively costly studies. They consider that though descriptive epidemiology has produced hypotheses that cover some of the observed facts, it has failed, with a few notable exceptions, to satisfy the major canon of an empirical science that a good working hypothesis should lead to action with predictable results.

The statistical method in particular cases may permit the solution of an epidemiological problem; but in those instances in which many unknown variables are concerned, and many assumptions are possible, the statistician is hampered by lack of any indication as to which possible assumption he should select.

By attacking particular problems the bacteriologist has been able to demonstrate the part played by certain specific parasites and the host's reaction to them, and by applying this knowledge has been able to interfere successfully in the course of events. But Topley and his co-workers think that the bacteriologist has not been able to put together his pieces of the puzzle so as to achieve a synthesis that bears more than a patchy resemblance to the picture that his colleagues have defined. They point out that we know that microbes of the same species vary in virulence and this may affect their powers of spread; that the resistance of hosts of the same species varies in its reaction to any given microbe; that there is a tendency for one attack of infectious disease to leave behind it an increased resistance to attack by the same organism; that this immunity varies in different diseases, is very effective in virus diseases, but less so in many bacterial diseases.

These factors and many others operate in the natural evolution of an epidemic, but it is their relative importance that we wish to know and the exact way in which they interact with each other. It is in the solution of problems of this nature that the method of the experimental epidemic can be applied.

One of the first problems investigated was the effect of interference in the

course of events in an infected herd recruited by continuous immigration. But before attempting to determine the effect of any particular method of interference it was necessary to know what happens to an infected herd when left to its own devices. Herds infected with mouse typhoid, mouse pasteurellosis and a virus disease, ectromelia, have been studied.

As regards the general course of events within an infected herd, Topley and Greenwood conclude that in herds of mice living in close and continuous contact and subject to the continuous or intermittent migration of susceptibles the disease will never normally die out. In a small herd it might happen that no individual was left either clinically sick or a carrier and the disease might die out. But in a large herd the studies showed that the disease will be perennial.

The rate of immigration is important; with low rates of entrants there will be well-separated waves and quiet intervals; with large immigrations there will be only minor fluctuations or an almost steady death rate. But this condition of equilibrium is unstable and when it is disturbed by some extrinsic or intrinsic factor there may be violent fluctuations before equilibrium is again established at the same or some other level.

In epidemics caused by virulent strains of *Bact. aertrycke*, *Past. muriseptica* or the virus of ectromelia, the rate of mortality is very high in the early days of herd life, but towards the fortieth and sixtieth days of cage life tends to a constant low level. The expectation of life of the surviving mice rises after the twentieth to thirtieth day to a level which, though in excess of that of new entrants, never reaches the level of mice in the same environment, but not exposed to contact with an infective disease.

Natural selection and immunization play a part in the increased average resistance of the surviving mice. It is thought that natural immunization plays a more important part than natural selection by the death of the more susceptible mice.

The studies are considered to have proved in the case of mouse typhoid, and probably in the case of the other diseases investigated, that under the conditions of the experiments infection occurs very early in herd life. An infected herd is regarded as a highly complex system consisting of mice suffering from a fatal infection; others in a state of infectious equilibrium that ends in death or recovery at some later period; others undergoing natural immunization by infection of a slighter degree; and a small minority not yet infected.

A very small proportion of the mice, owing to a natural resistance to the access of bacteria or viruses to the tissues, may remain unchanged in their immunological constitution in spite of repeated doses of the parasite, but their ability to escape infection is never absolute.

The occurrence or non-occurrence of differentiated waves of mortality is due to the equilibrium established in the complex system, which may be shifting or temporarily stabilized. The epidemic waves are not due to any

fixed cycle of bacterial or virus development, to seasonal or similar disturbances, or indeed, to any single determining cause.

It is thought that the mortality in the herd and the ratio between immunizing and disease-producing infections depends on the characters of the bacterial strain which initiated the epidemic. Virulence and infectivity vary independently and an epidemic strain has both these characters. Changes of this kind are not supposed to play a part in the sequence of epidemic waves during any given epidemic prevalence.

The normal course of events in an infected herd may be affected by artificial immunization. Diet has been suggested as having an influence, and also the action of bacteriophage. The studies have shown that artificial immunization is the most effective method of interference yet available. It will raise the expectation of life of the new entrants to the herd almost to the level of those which have felt the full effects of natural immunization and selection.

Artificial immunization was found more effective in a virus disease such as ectromelia than in a bacterial disease such as mouse typhoid.

Prophylactic immunization against mouse typhoid was not very successful ; the reasons for this were the low average immunity induced in the vaccinated mice and the continuous and severe risk of infection to which the mice were exposed. This continuous risk is considered to render it impossible to draw conclusions as to the probable effect on human herds of a prophylactic immunization yielding a relatively low average level of immunity.

Topley and his co-workers state that they do not know the level of immunity induced by ordinary typhoid or T.A.B. vaccine. They consider the best data available are those prepared by the Anti-typhoid Committee nearly a quarter of a century ago. The figures relate to short periods of exposure of one to two years. They show that the attack rate among the inoculated is about one-sixth of that in the uninoculated. This does not indicate any absolute immunity.

The data given in the Medical History of the Great War are considered unsatisfactory. Again, there was no absolute protection. Inoculated men formed an immense majority of the exposed to risk, and the incidence of typhoid fever during the campaign was much less than in peace time or the Boer War. Topley and his co-workers do not doubt that protective inoculation was one factor of this great improvement, but see no ground for making it responsible for the whole improvement. The system of hygienic organization was far superior in the western theatre of war in 1914-18, than in the South African campaign. The lesson they draw from their experiments is that given transient or intermittent exposure to infection the immunity induced will reduce the incidence of the disease to relatively small proportions. Even if the exposure to risk is severe and continuous the vaccinated will fare slightly better than the unvaccinated. They consider that the vaccines now available will not afford protection

against all probable risks and therefore general measures of hygiene should not be disregarded or relaxed.

A more effective method of immunization might allow typhoid infection to be controlled by this means alone. An intensive study of the antigenic structure of bacteria is now being carried out by Grumell; Perry, Findlay and Bensted; and by Felix and Pitt. This work gives ground for hope in this direction.

The experiments on prophylactic immunization against ectromelia showed that by the immunization of mice with two injections of formolized virus, the second of which is living but attenuated, it is possible to induce a level of immunity against a subsequent massive injection of fully virulent virus far higher than can be obtained in vaccination against mouse typhoid. They suggest that even under the severest conditions of prolonged exposure a relatively high degree of protection may be attained.

In ectromelia and most probably in the bacterial diseases many of the immunized and infected survivors were infective for normal mice, so it is very doubtful whether by this method we could eliminate infection from the herds and so render safe the entry of susceptible immigrants. In the case of mouse typhoid the conditions of exposure were severe and it is thought possible that with more restricted contact the results might be more favourable.

Among the non-specific factors which influence the host's resistance to disease diet is considered to have an important influence. But apart from the fact that gross deficiency in vitamin A renders animals more liable to infection, the studies did not enable any definite conclusions to be drawn as to the influence of diet on resistance or susceptibility; all the experiments gave consistently negative results. Too little is known about the nutritional requirements of the mouse, and Dr. Marion Watson is now engaged on this study and when her results are known it is hoped to test her findings under conditions of epidemic spread.

Dr. Herelle has claimed that the bacteriophage has an important influence on the epidemic spread of infection, and other workers have made similar claims in relation to cholera. If bacteriophage be accepted as the generic name for a multitude of filtrable viruses adapted to prey on particular species of bacteria, Topley and his co-workers consider that there may be grounds for the belief that a specific phage of adequate virulence is an ideal agent for the control of epidemic disease. Unfortunately all their experiments gave negative results. Many hundreds of strains of *B. aertrycke* isolated from infected mice were examined for sensitivity to the phage under test. In only one instance was a resistant strain encountered. Therefore, the negative results could not be due to the appearance of modified strains resistant to the phage employed. A criticism might be urged that the phages had not a maximal activity. It

is true that none of them produced the complete clearing of broth cultures associated with phages of the most active type. But Dr. Herelle has stated that a weak or moderately active phage is sufficient to render the animal resistant to infection, the bacteria being destroyed in the intestine before they can multiply.

Topley and his co-workers, limiting themselves to the epidemiological viewpoint, consider that there is no support for Dr. Herelle's claim that the rise and fall of an epidemic merely registers the fluctuations between the pathogenic bacteria and the phage. They have shown that an active phage may be distributed at large among a herd at risk during the rise and peak of an epidemic wave, but its presence makes no significant difference to the epidemic process.

With regard to cholera they point out that this is the classical example of a pure intestinal infection. It is possible that phage action may be effective in such a disease even if quite ineffective in diseases in which tissue invasion is an essential factor in the production of the clinical syndrome.

Experiments on the effect of dispersal on an infected herd have been made, but the observations are stated to be too fragmentary to serve as a basis for discussion.

The experiments, however, suggest that when dispersal is carried out at the beginning of an epidemic period, the division of a herd into many small isolated units greatly decreases the mortality during the succeeding ten weeks or so, and that although the re-aggregation of such a herd is followed by a fresh spread of the disease, the final mortality is lower than in a similar herd that has not been dispersed during the earlier stages.

In the last section of their report the authors consider the significance of their findings in relation to events in the natural world outside the experimental cages.

They consider that their observations are in accord with the view expressed by Hamer in 1906, that the periodicity of such an epidemic disease as measles is probably due to periodic changes in the constitution of the population exposed to risk leading after each epidemic wave to a gradual re-accumulation of susceptibles. The natural epidemic waves correspond to the widely-spaced waves observed with very slow rates of immigration, or with the effect produced by adding susceptibles to the population surviving from an epidemic prevalence. In the natural world re-accumulation of susceptibles is by births rather than by immigration; but in specialized herds, such as schools in general and boarding schools in particular, Dudley's observations have shown that immigration of non-immunes term by term is probably the decisive factor in determining the course of events. In the common epidemic diseases from which most people suffer at one time or another, but which occur in epidemic form at widely-spaced intervals, the ever-varying state of the immunological

constitution of the herd is the main factor determining the intervals at which epidemic waves occur. The immunological constitution is determined by sublethal or latent infection, which is regarded as the essential factor in the immunization of any human herd.

In relation to the relative importance of innate, as compared with acquired immunity, Topley and his co-workers point out that a thousand year's exposure to measles, a disease that exerts its main killing power before puberty and should exert a maximal selective effect, has not sufficed to lower the incidence in the slightest degree, while the minimizing effect of a wave of disease is too obvious to need comment.

Though seasonal influence on the mortality was not demonstrated in the infected herds, it is one of the commonplaces of epidemiology. It is considered that seasonal should not be interpreted in a purely meteorological sense. That heat, cold and humidity have an indirect effect is well established; but social events have also a seasonal rhythm. The breaking up and re-assembly of schools are independent of weather conditions, and many social happenings will have an indirect effect on the immunological constitution of the various herds at risk and will exert a seasonal influence.

The existence of epidemic strains of bacteria which has been postulated by many epidemiological workers has been confirmed by the experimental studies. The experiences of Dudley and Breman at Chatham, where eleven cases of cerebrospinal fever with only one death were followed for seventeen months by a non-contact carrier rate of 54 per cent without the occurrence of a single case of disease, suggest that epidemic behaviour will depend on the biological characters of the strain, and that the ratio between immunizing and disease-producing infection holds an important place.

As regards the closeness and continuity of contact the experiments recorded are of peculiar interest in connexion with school dispersion and closure. A few years ago there was considerable correspondence in the daily papers on the advisability of early closure and dispersion of one of the large public schools in which cases of poliomyelitis had occurred. The school was dispersed early without any further development of cases among the scholars or home contacts. Greenwood and Topley write that if we compare the effect of dispersing an infected herd of mice with the probable effect of school closure during an epidemic prevalence and confine our attention to the effect on the boys and girls exposed to risk, the suggestion is that the nature of this effect will depend in the main on the stage of the epidemic process at which the school is closed. If it is closed early when only a small proportion of those at risk are infected the advantage reaped by the scholars will probably be large.

Practically, ignoring the possible effect on home contacts, we can say that the possible benefit of closure on the discovery of clinically diagnosable cases of any disease will depend on the ratio of "carriers" to "cases"; if this ratio is low prompt closure will be effective; if the ratio is high

closure might not greatly lessen the scholar's risk. There can be no general rule; we must know the immunological constitution of the herd before we can assess the probable effect of dispersing it.

With regard to the importance of velocity of infection suggested by Dudley as a result of his field studies of diphtheria: Topley and his co-workers state that from their experiments they are inclined to view this problem rather in terms of the relative velocities of immunization and disease production within a herd than in terms of the relative velocities of reception and elimination of the parasite. Their observations suggest that so far as the individual is concerned, the probability of immunization or death may be largely determined by the size and spacing of the doses of the parasite received. Turning to possible methods of interference with the natural course of events they state that artificial immunization has afforded the only significant results, though in the conditions of their experiments the successes have not been so great as those recorded from the field. They consider that so far as our present methods of immunization are concerned there is no indication that a lowering of mortality is associated with an equivalent lowering of infection. Many immunized survivors are apparently infected and infective. If this applies to field immunization in an equal degree they think there is little hope of the complete elimination of any particular infective disease along these lines. If it were possible to induce an active immunity that prevented infection as well as disease the immediate position would be more hopeful, though even then the danger of re-importation might prove formidable if immunization were relaxed.

Apart from general hygienic methods designed to lessen the opportunities of infection they think that active immunization is likely to remain the procedure which, acting alone, will exert an important effect on the prevalence of an infective disease. But they consider that the acceptance of this view does not warrant the neglect of the study of other factors which may be of cumulative importance. Records of descriptive epidemiology show that the disappearance of an endemic or epidemic disease is more often the result of the termination of many effects than of any single known factor. The identification of these accessory factors and the assessment of their relative importance will involve the study of large groups of animals under controlled conditions and for this research experimental epidemiology offers many advantages.

Clinical and other Notes.

NOTES ON HENRY'S MELANO-FLOCCULATION TEST AS AN AID TO THE EARLY DIAGNOSIS OF MALARIA.

By Captain H. B. WRIGHT,
Royal Army Medical Corps.

Henry[1] in 1928 described a method of diagnosing malaria from the blood-serum which he called the melano-flocculation test. He showed that the serum of a patient suffering from malaria, when added to a solution of melanin, causes a gelatinous flocculation to appear after some hours. This flocculation he found only occurred with malaria sera. In 100 healthy sera examined the reaction was negative, and in 450 malaria sera it was positive.

The technique of the reaction is briefly as follows :—

The solution of melanin is obtained by grinding ox choroid membrane with sand and distilled water; a clear dark filtrate results after centrifuging and filtering through chardin paper. The serum to be tested is added to the melanin solution, and together with controls of normal saline and distilled water is then incubated at 37° C. for three hours. Positive sera show a brown coloured flocculation at the bottom of the tubes and negative sera show no change.

Since Henry's findings were published a considerable amount of work has been done on this test on the Continent, but it was not until last year that the subject was taken up in England by Greig, van Rooyen and Hendry. They introduced a new method of preparing the melanin solution by extracting the pigment from human hair. This provided a more stable reagent, free from foreign protein and possessing the advantage that different dilutions of serum could be made with it so as to show different degrees of "positivity." The dilution of serum giving a positive reaction in the average malaria case at the end of four weeks was found to be as high as 1 : 128. Using this extract of melanin they were able to demonstrate positive results in some cases of experimentally induced malaria some days before the first rigor occurred.

Henry himself claimed that his reaction was seldom positive before the fifth day of the fever ; Chabrelic estimates it at the ninth or tenth rigor, yet Alcay, Cattoir and Marill found it positive in three cases out of eight before the first rigor.

The nature of this reaction is obscure. Henry held that malaria serum possesses the power of agglutinating melanin, but Chorine (1933) showed that negative sera could be made positive by adding euglobulin, and holds the view that the reaction is a precipitate of a euglobulin fraction by the distilled water contained in the melanin solution. Wiseman has in fact demonstrated a

parallel series of tests using distilled water and melanin, and in every case where the melanin tubes were positive the distilled water controls were positive too; in some cases the distilled water controls showed a positive reaction with malaria sera when the melanin tubes were negative. As further proof of the possibility of the reaction being due to a euglobulin excess Chorine mentions kala-azar, a disease where the euglobulins are greatly increased, which often gives a positive result with this test. Hæmolytic jaundice, typhus and pemphigus have also been shown sometimes to give positive readings.

The writer recently had an opportunity of trying out this test on a selected series of cases. The object was to discover if the test would be of help in diagnosis in those early cases of malaria where the parasites in the peripheral blood are scanty and only with difficulty seen in the blood-film. Many of the cases examined had been receiving prophylactic quinine, and all were British troops with no previous history of fever since arriving in India. Control sera were taken both from healthy volunteers and from patients with various non-malarial fevers.

The results are tabulated as follows :—

EXPERIMENT I.—Sera of malaria cases taken within twenty-four hours of the first rigor.

Case No.	P.	O.C.M.	D.W.	M.	
1	M.T.	Neg.	Neg.	—	Hair melanin not available
2	B.T.	Pos.	Pos.	—	
3	B.T.	Neg.	Neg.	—	
4	B T.	Neg.	Neg.	—	
5	B.T.	Neg.	Neg.	—	
6	B.T.	Neg.	Neg.	—	
7	M.T.	Neg.	Neg.	—	
8	B.T.	Pos.	Pos.	—	
9	B.T.	Neg.	Pos.	—	
10	M.T.	Neg.	Neg.	—	
11	B.T.	Neg.	Neg.	Neg.	
12	M.T.	Neg.	Neg.	Neg.	
13	B.T.	Pos.	Pos.	Pos.	
14	B.T.	Pos.	Pos.	Pos.	
15	M.T.	Neg.	Neg.	Neg.	
16	B.T.	Pos.	Pos.	Pos.	
17	M.T.	Neg.	Neg.	Neg.	
18	B.T.	Neg.	Neg.	Neg.	
19	B.T.	Neg.	Neg.	Pos.	
20	B.T.	Neg.	Neg	Neg.	
21	B.T.	Pos.	Pos.	Pos.	
22	B.T.	Neg.	Neg.	Pos.	
23	M.T.	Neg.	Neg.	Neg.	

P. = Parasite. O.C.M. = ox choroid melanin. D.W. = distilled water.
M. = melanin extracted from hair.

EXPERIMENT II.—Ten cases of non-malarial fevers—one (enteric) was positive to distilled water only, the rest were all negative to all three reagents.

EXPERIMENT III.—Fifteen sera from healthy troops with no previous history of fever—all were negative to all three reagents.

It will be noticed that the melanin prepared from hair was only used

in a few of the malaria cases as it was received from Edinburgh too late for use in all ; sera kept for longer than twenty-four hours rapidly lose the property of flocculating melanin, a fact which Chorine and Kocchlin have pointed out.

CONCLUSIONS.

From the above table it will be seen that the reaction is not very often positive in the early stages of the disease when, in the absence of parasites, it would be of considerable diagnostic value; yet the writer feels that the almost consistently negative results in the non-malarial fevers and in the normal sera examined are in favour of the test.

As the reaction is known to be inhibited in sera taken at the height of the rigor, all the malaria sera were taken after the temperature had begun to fall—that is, within twenty-four hours of the onset. In many cases the temperature was still above normal, especially in those with malignant tertian parasites, which may account for the fact that in none of the malignant tertian cases was the reaction positive. Koch and Vohwinkel (1933) found the reaction frequently negative in cases of untreated malignant tertian infection, and a possible explanation may be found in the continuous nature of the temperature in this variety. The reaction with distilled water appeared to be more sensitive than with choroid melanin, but it gave one positive erroneous reading. The melanin prepared from hair seemed to be the best reagent of all three and gave more positive results than the ox choroid solution, while giving negative results in all the controls.

As a result of these very brief investigations, the writer is convinced that the test is well worth carrying out in early cases of fever where no parasites can be found. Although negative results are valueless, positive results are strongly suggestive of malaria and would appear to justify that final shot in the diagnostic locker "response to quinine." Of the uses of the test in the later stages of malaria, where it appears to have more value, the writer has no experience.

I am indebted to Colonel I. M. Macrae, C.I.E., O.B.E., I.M.S., A.D.M.S., Peshawar District, for permission to forward these notes for publication, and to Colonel E. D. W. Greig and Dr. Hendry, of Edinburgh University, for so kindly sending me out supplies of their melanin extract.

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AN ADDITIONAL CASE OF DENTURE IMPACTED IN THE AIR PASSAGES.

By Major H. A. SANDIFORD, M.C.,
Royal Army Medical Corps.

The following notes of a case of a denture impacted in the air passages, additional to the cases reported by Major S. H. Woods [1] in this Journal, are rather sketchy as the case occurred some seventeen years ago and reliance has had to be placed on memory alone to supply the details.

In October, 1919, I sailed for India in the s.s. "Kashgar," with about 1,500 troops on board, and at the time of sailing a railway strike was in progress at home, resulting in the second medical officer and the R.A.M.C. orderlies missing the boat. The Ship's Surgeon, Dr. Porter, who had been recently demobilized from the R.A.M.C., willingly gave a hand and some members of the Nursing Service, who were proceeding to India, volunteered for duty in the troops hospital. This assistance proved invaluable, especially when influenza broke out and some two dozen cases of pneumonia occurred.

About twenty-four hours out from Gibraltar, at about 10.30 p.m., I was summoned to see Private F. B., aged 19. He was coughing violently, had great difficulty in breathing and complained of a violent pain in the chest. He stated he had fallen asleep about half an hour previously and had wakened up coughing and had lost his artificial tooth which had been in position in his mouth when he climbed into his hammock. The patient, cyanosed and deeply distressed, was removed to the troops hospital. It was fairly obvious that the artificial denture had dropped down the food or air passages, but its exact location was by no means clear, and no X-rays were available.

The fauces were cocainized and the larynx inspected and found clear; a stomach tube was passed without difficulty. The patient was put to bed and observed for the next twenty-four hours. During this time he had periodical attacks of coughing with intense pain referred to the area over the sternum; morphia was given to relieve the pain.

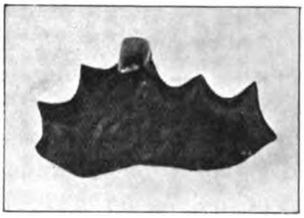
Several attempts were made to dislodge the denture by suspending the patient, head downwards, and violently shaking him and banging his back, tracheotomy instruments being held in readiness in case the denture impacted in the larynx. In spite of these efforts no change in the patient's condition was noticed.

About 8 p.m. next day, i.e. about twenty-two hours after the accident, as the patient was becoming more deeply cyanosed and the pain and cough rather more frequent it was decided to explore the trachea.

The Ship's Surgeon gave the anæsthetic and the trachea was opened as low as possible in the neck. Unfortunately no trace of any foreign body was felt within reach of the exploring instrument. A tracheotomy tube

was inserted and the patient put back to bed. Death from asphyxia occurred about 2 a.m. next day, i.e. about twenty-eight hours after the accident.

A post-mortem was performed at 6 a.m. and the denture shown in the accompanying photograph was found at the bifurcation of the trachea.



The sharp points of the denture were embedded in the mucous membrane and the denture lay across the bifurcation. Swelling of the mucous membrane from œdema had gradually completed the occlusion of the airway.

The denture, which bears one small gold tooth to replace an upper incisor, was worn for æsthetic reasons and was not supplied by the Service authorities.

I have to thank Colonel A. C. Hammond-Searle, M.C., Commandant, Army School of Hygiene, for permission to forward this note for publication.

REFERENCE.

[1] Journal of the Royal Army Medical Corps, April, 1936, p. 240.

Echoes of the Past.

WAR EXPERIENCES OF A TERRITORIAL MEDICAL OFFICER.

By Major-General Sir RICHARD LUCE, K.C.M.G., C.B., M.B., F.R.C.S.

(*Continued from p.* 205.)

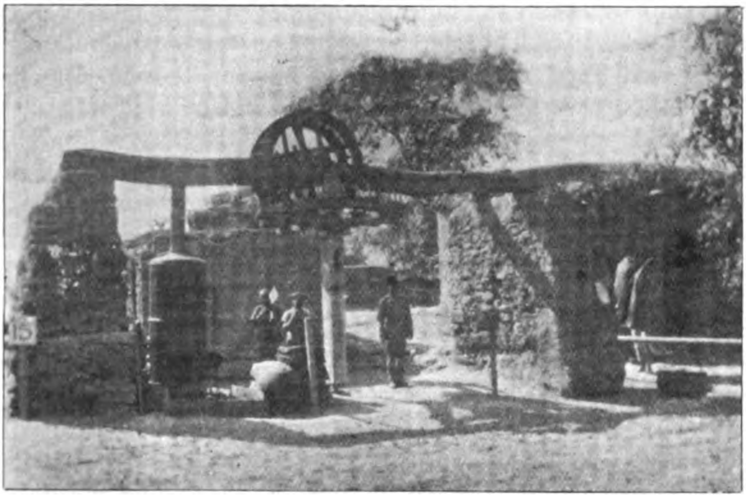
Chapter XIII.—The First and Second Battles of Gaza.

During the next few days our infantry were pouring into Rafa and by the 23rd the whole force, consisting of three infantry divisions, the 52nd, 53rd and 54th, two mounted divisions and the Camel Corps, was within striking distance of the enemy.

The morning of March 26 was fixed for the attack on Gaza. The 53rd Division, our old friends of Gallipoli and the Western Frontier, still commanded by General Dallas, was to have the place of honour, supported by the 54th Division. The 52nd was in army reserve. The command of

the attack was entrusted to Sir Philip Chetwode, G.O.C. of the Desert Corps. Sir Charles Dobell, the Force Commander, was on the ground and held the 52nd Division in his own hands. General Murray came up from Cairo for the occasion but did not take personal command. The attack was to be delivered at dawn. The rôle of the two mounted divisions and the Camel Corps was to cross the Wadi Ghuzzeh well to the east of Gaza, under cover of darkness, and moving round behind the town to form a cordon covering it from the north and north-west.

The Turks were known to have considerable forces at Beit Hanun to the north and at Sheria on the Beersheba line to the north-west. The duty of the mounted troops was to hold off any reinforcements the Turks might send up during the attack on the town.



Well at Khan Yunus.

The day before the move, March 25, was given up to a race meeting at Rafa, partly to mislead the Turks and partly to cheer the troops. It was held on a lovely piece of even ground close to Magruntein Hill, the scene of the battle of the month before.

Railhead had now reached Khan Yunus, an extensive village about five miles north of Rafa. Here the 54th Casualty Clearing Station had been opened for reception of casualties from the forthcoming battle. A supply of motor ambulances had been brought up as the country here was suitable for this form of transport. Only a very limited number had, however, arrived and none were actually placed at the disposal of the Mounted Division. We left camp on the morning of March 25, and crossing the sand dunes at Rafa moved northwards along the beach. The village of Deir el Belah, four miles from the Wadi and nine miles from Gaza, was reached about four p.m. Here the whole division was assembled.

Jaffa oranges were now in season and the natives had a small store for sale, but it did not take many days for our hungry army to exhaust all the supply that existed south of the Turkish Army.

Our Headquarters bivouac was in a charming orchard of figs, almonds and pomegranates. The pomegranates were in full bloom and their lovely masses of scarlet were a refreshing sight after the desert we had crossed. The house was a red-tiled modern building and belonged, we understood, to a Greek doctor in Gaza, who used it as a summer residence, but it had evidently been used for some time by Turkish officers as we found in an outhouse a goodly array of empty bottles many of which bore the names of German vintages.

Soon after dusk the Divisional Staff was summoned to hear the plans for the morrow and after this I had to draw up the medical orders for the three field ambulances by the light of a single candle beneath the open sky. We had left all kit that could not be carried on the horse at Rafa and as we were taking two days' rations there was not much room for office paraphernalia. All orders had to be written out and reduplicated with carbon papers in a field message book. The mobile sections of the three field ambulances and the immobile sections of the 5th and 6th Mounted Brigade grouped together, were to march out for our long trek at the rear of the column. The mobile sections were subsequently to rejoin their respective brigades and the two immobile sections to form a dressing station at the point on the Gaza-Beersheba road where it was crossed by the column. Here casualties were to be collected and retained until the end of the operation when they were to be evacuated by motor car, under arrangements made by the D.D.M.S. of the Desert Column, to the 54th Casualty Clearing Station at Khan Yunus. After getting the orders distributed a a few hours were given up to a sleepless rest.

The Anzac Division moved out in front of our own as it had further to go; they were to hold the ground north of Gaza from the sea to Huj, we were to take that on their right from Huj to the Beersheba road and the Camel Corps behind us from the Beersheba road to the Wadi.

We started off about 1.30 a.m. The night was hazy and dark. The first part of our journey through the enclosed fields of Deir el Belah was rough going in the darkness. We seemed to be continually passing through gaps in cactus hedges with very deep ditches and more than one member of the Divisional Headquarters came to grief in negotiating them. The check at the gaps made it very difficult to keep touch in the darkness. After a while we got into more open country and then the slow march went on through the night. The fog became increasingly thick and the halts in front frequent. En route we passed the bivouac camps of the infantry. As dawn came we reached the banks of the Wadi which were very steep and rough. The fog did not clear till 10 a.m. and by this time we had reached the Gaza-Beersheba road where the Division assembled.

We moved on another mile or so and the troops were thrown out to

form a cordon. The 5th Mounted Brigade took the right flank, the 6th the centre and the 3rd Australian Light Horse were facing north, in touch with the Anzac Division which was on their left.

It was beautiful open rolling country. We were on high ground, broken on our left by the sharp almost insurmountable ridges of Mansura. Gaza and the sea lay beyond. From a point just west of us we could look down over the plain in front of Gaza across which the infantry must advance. We were not left altogether undisturbed. As soon as our brigades began to deploy, the Turkish artillery, from the direction of Sheria, started to pay us attention, but only effected one or two casualties.

The fog of the early morning had held up the infantry attack on Gaza which should have been delivered at dawn. It was not until noon that they were in a position to make the assault. From our point of vantage we could clearly see the 53rd Division about six miles away advancing in successive waves across the open plains and with glasses we could even see the gaps occurring in the lines as they moved.

Fortunately several wells had been found in the area we were occupying and practically the whole of our horses were watered in the course of the morning.

About 3 p.m. we were ordered to move forward to take over the ground hitherto held by the Anzac Division, who were now ordered to face about and make an attack on the town from the north. Our headquarters moved eastwards about three miles, to Beit Durdis, which was little more than two miles north of Gaza itself, but hidden from it by hills.

At 4.30 information was received that strong Turkish reinforcements were approaching from two directions, from Beit Hanun to the north and from Sheria to the east. The 3rd Light Horse and the 6th Mounted Brigades were moved forward to check them and soon a certain amount of rifle fire began. Our two Horse Artillery batteries were moved up to support the brigades and the enemy's advance seemed to be stopped for the time.

In the late afternoon we heard that the infantry attack from the south had not succeeded in taking the town and that we might have to return the way we had to come as soon as it was dark. Orders were sent to the dressing station to pack up and be prepared to move back, taking their patients with them.

The 5th Mounted Brigade had had a few casualties from shrapnel during the early part of the day but had never been seriously engaged. Each brigade was accompanied by the mobile section of its field ambulance and they were told to be prepared to bring back with them across the Wadi any casualties that might occur.

Darkness came down on us and with it the order to retire at 8 p.m. The main body of the staff was at the time separated from the General and in the darkness touch could not be regained. After some attempt to find him we started off on our weary march back over the ground we had

traversed so hopefully in the morning. It was a lovely starlight night so that there was no real need of the luminous compass though the course set us by the officer in charge was at first too much to the east and if we had pursued it, would have taken us into the lines of the oncoming Turks. As it was at one point of the route we passed through several groups of dark figures lying on the ground and we were quite uncertain whether they were friend or foe. They did not challenge us nor we them and we rode on in absolute silence until they were passed. Who they were we never knew. After stumbling along in the darkness for some hours about midnight we crossed the bed of a wadi which we took to be the Wadi Ghuzzeh and then halted and bivouacked till dawn. All night long mounted troops kept passing us often shouting to one another in the darkness to keep touch.

When dawn broke we found we were still about half a mile north of the main wadi and that the troops of our division were still trekking by. As soon as it was light Turkish guns began to open upon us, showing that they were closely following the rearguard which proved to be only just behind us. We were not long in saddling up and joining in the procession.

As we made our way back to Deir el Belah we began to hear what had happened. The 53rd Division, owing to their late start, had been unable to take the town. They had captured Ali Muntar and been driven off it again. Our friends the Anzac Division had got right into the town from the north but had had to come out again when the general withdrawal was ordered, though they had taken 700 prisoners, including a Turkish Divisional General caught in his carriage, trying to make his way into Gaza from the north. The Anzacs had even brought away with them several Turkish guns. It was a sad disappointment to have failed when so near success.

Our own casualties had been quite light and our field ambulances were able to bring all the wounded away with them, though it meant that the sand carts designed for two patients had to find room for four. The so-called immobile sections, the only part of the Division that had to foot it, had marched twelve miles to their position on the Beersheba road, stayed on duty there all day and marched twelve miles back during the succeeding night taking their patients with them; no mean performance for a unit with such a name.

The Division assembled on the plain near Belah and from noon till 4 p.m. bivouacked and rested around a big solitary tree, under a burning sun with a *khamsin* blowing. Then off we had to go again to take up a line of outposts on the hills about six miles east of Belah.

The casualties of our Division were only about thirty, but of the infantry, both the 53rd and 54th lost very heavily, the total number of casualties being about four thousand.

The 52nd Division did not take part in the action.

There was considerable anxiety lest the Turks, emboldened by their

successful defence and reinforced as they were, might make a counter attack on our right flank. To be prepared for this our outposts on the hills were kept on the *qui vive* for two days. During the whole of this period the *khamsin* was blowing and, tired out with our long ride and the excitement of the battle, we were most of us done up. Moreover, our Divisional Headquarters' messing arrangements had broken down. Owing to severe cutting down of numbers, the cook of our mess was left behind and our grooms did not make good substitutes. We were not sorry, therefore, to move back once more to our old quarters in the orchard at Deir el Belah and to get a respectable meal and a bathe in the sea after not having had our clothes off for five days.

A pause was inevitable before a renewal of the offensive could be undertaken. The infantry were withdrawn to the south bank of the Wadi and proceeded to entrench themselves.

The 74th Division, recently formed out of dismounted Yeomanry brigades, most of which had served in the Western Frontier Force, was on its way up and it was decided to await its arrival which would not be completed for another three weeks.

As far as we were concerned the time was chiefly spent in resting and recovering, though our brigades had to take turns in holding the line of outposts on the hills to the east of Rafa.

Medically, we devoted this time to restoring sanitary discipline which is always apt to get a bit slack during active operations, especially in the case of mounted troops, and to safeguarding our various water supplies.

Besides the fresh water on the beach there were many deep wells in and around the village of Deir el Belah, some of which were fresh enough to drink, though others were so brackish that they were only fit for watering animals.

The lake at Belah, which is of considerable area, was too salt for human consumption but could be used for watering horses and camels. One of my own ponies was a long time convincing himself that this water was fit for horses to drink.

Our Fourth Brigade, the 4th Australian Light Horse, now joined us. Another reinforcement was also coming forward which might be mentioned only with bated breath, namely a small consignment of tanks from the use of which much was hoped. The railway had been brought forward to Belah and with it had come two casualty clearing stations, the 53rd and the 54th. Gradually plans for the next operations began to mature. Our Division was again to be on the right flank, but our rôle was a very different one this time. The Turks had not failed to take advantage of the respite we were giving them. They had tremendously strengthened their position by skilful and energetic digging.

The gap in their line of defence between Gaza and Sheria through which we had ridden in the previous battle was filled up and a very strong entrenched position prepared on raised ground known as the Atawineh

Ridge, close to the point where our dressing station had been on the Gaza-Beersheba road during the first attack. It was no longer possible, therefore, to ride round the enemy's flank. This time, while the infantry was once more making a frontal attack on the southern defences of Gaza, our Division was to make a dismounted attack on the Atawineh Ridge. Our colleagues, the Anzac Division, were to remain mounted and cover our right flank.

April 19 was the day fixed for the attack. On the 16th our division moved out to Tel el Jemmi, a small flat-topped hill rising out of the bed of the Wadi Ghuzzeh about seven miles from its mouth and about two miles east of the point where we had previously crossed.

On the afternoon of the 18th I rode out with the field ambulance commanders to reconnoitre the ground in front and to select positions for advanced dressing stations for the division.

We went forward about four miles and selected a place by the side of the Wadi Sihan, a northern tributary of the Wadi Ghuzzeh, more or less out of view of the enemy's position and at a distance of about five thousand yards from it. There was a track leading down from here to Tel el Jemmi suitable for wheeled vehicles and possibly, with détours, for motor ambulances if the latter could be got across the Wadi Ghuzzeh. This was at first uncertain owing to its steep sides and sandy bottom.

In the plan for medical evacuation we arranged to have a divisional collecting dressing station at Tel el Jemmi, to form which the immobile section of the 6th Mounted Brigade Field Ambulance had been brought up.

The immobile sections of the 3rd Light Horse and 5th Mounted Brigade Field Ambulances were left near railhead to take over the sick and lightly wounded cases from the division in relief of the casualty clearing stations there.

The main divisional dressing station was to be at Aserferiyeh, the place we had selected in the Wadi Sihan. For this operation the field ambulances were worked as divisional units under the direct orders of the A.D.M.S.

The main dressing station was to be formed by the 3rd Australian Light Horse Field Ambulance. The 5th Mounted Brigade Field Ambulance and the 4th Light Horse Field Ambulance, now working for the first time, were to form advance dressing stations in rear of their brigades. The bearer divisions of the 3rd and 4th Light Horse and the 5th Mounted were to collect wounded from their respective brigade fronts.

The 6th Mounted Brigade Field Ambulance, whose brigade was in reserve, was kept also in reserve at Divisional Headquarters about a mile behind Aserferiyeh.

It was still uncertain if the motor ambulances would be able to get up to the main dressing station, so half the sand carts were to be employed for collecting from the advanced dressing station and regimental aid posts up to the main dressing station, the remainder working between this point and the collecting station at Tel el Jemmi.

We moved out from Tel el Jemmi before dawn on the morning of the 19th, and the battle began all along the line soon after it was light.

The 52nd, 53rd and 54th Divisions were attacking Gaza with the 74th Division in reserve.

In our own attack the 5th Mounted and the 3rd and 4th Light Horse were in the firing line in this order from right to left. The brigades dismounted about three miles from the enemy's position and the horses were left hidden in the various branch wadis that intersected the ground.

The troops went forward with great dash and the Australians occupied the front line of Turkish trenches in a very short time, but a devastating machine gun fire drove them out again.

All day they made repeated but unsuccessful attempts to push on, and their casualties were very heavy.

The main dressing station was soon hard at work, and evacuation proceeded regularly and smoothly. About noon the satisfactory news was received from the officer in charge that with the help of the engineers he had managed to get the Ford motor ambulances across the wadi at Tel el Jemmi by constructing ramps down the steep banks. It was found that by making détours round the ends of the intersecting wadis leading into the Wadi Sihan they could make their way up to the main dressing station. This was an enormous help as the volume of work still continued to increase.

Fifty led horses were requisitioned from the troops to carry back lightly wounded, and later another thirty. All the transport and bearers of the 6th Mounted Brigade Field Ambulance were sent up to help early in the day.

By 4.30 p.m. nothing further had been effected, and we were warned that a retirement would have to take place at 8 p.m. It was evident that if we continued to convey the wounded the whole way from Aserferiyeh to Jemmi it would be impossible to clear the main dressing station at the former place in time.

The O.C. of the 6th Mounted Brigade Field Ambulance was therefore ordered to open a subsidiary dressing station at the village of Mendur, about two miles nearer than Jemmi. This saved the situation for us. The main dressing station was cleared by 8 p.m. and the field ambulances withdrew with the troops to a line behind Asaferiyeh. All through the night the work of dressing and clearing the wounded went on at Mendur and Jemmi. The former was cleared before morning except for fifteen cases too bad to move. The divisional collecting station at Jemmi was not completely cleared until 3.30 a.m. on the morning of the 21st.

I spent the night between Mendur and Jemmi and had an unpleasant journey from the former place to the latter, just after midnight. After crossing the Wadi Ghuzzeh at Jemmi, riding with my groom, I managed to take the wrong turning and eventually struck the Wadi Sheria, on

which Mendur lies about two miles N.E. of Mendur. By that time I had discovered my mistake, and to avoid losing my way again I decided to follow the dry bed of the wadi down to the dressing station. It ran a tortuous course and was so horribly rough that it took two good hours to reach my destination.

The responsibility for removing the cases from Jemmi was entrusted to Major Lelean, the D.A.D.M.S. of the Desert Column, who took up his position there during the operations, and controlled the Motor Ambulance Convoy. The road to the casualty clearing station at Deir el Belah was a roundabout one ten miles long. It became so cut up that a new route had to be adopted in the middle of the operations.

The total number of wounded that passed through the collecting station at Jemmi between the morning of the 19th and the early morning of the 21st was 762, of whom 414 were from our own Division and the remainder from the Anzac Division on our right or from the Infantry on our left. The staff of the station was only three officers and fifteen men who in consequence did not have much time for rest.

The Division remained at Jemmi holding a line of outposts just north of the wadi until the evening of the 22nd when we were withdrawn to Beni Selah some ten miles back on the hills east of Khan Yunus. Here we remained with one brigade thrown out to the right flank towards Shellal occupying the fortifications which as mentioned before had been so carefully prepared by the Turks after their defeat at Rafa, but which they had never held against us.

The operation had been a trying one for the transport and there had been a heavy mortality among the camels. Their dead bodies were strewn about the country forming fine breeding places for flies and rendering the whole countryside nauseous.

Our sanitary section, which during the operations had been left at Rafa, now rejoined us and to them was entrusted the Herculean task of cleaning up. Fortunately they had among their ranks an individual who was described by his commanding officer as a specialist in destroying camels. On casually inquiring what was his occupation in civil life I learned that he was Modern Language master in one of our oldest public schools. He did not belie his reputation. With a gang of Egyptian Labour Corps men, a few tins of paraffin, and some bales of chopped straw or *tibben*, he soon made the atmosphere of our area breathable once more.

The infantry attack on Gaza had been no more successful on this occasion than the last. They found the enemy strongly reinforced and the defences greatly improved. The losses were even heavier than before, reaching a total of 7,000. The only result gained was that our line was established some three miles nearer Gaza. The troops proceeded to dig themselves into a line of trenches facing those of the Turks.

Some changes took place in the Higher Command after this battle. Sir Philip Chetwode succeeded Sir Charles Dobell in command of East

Force and General Chauvel took command of Desert Column in place of General Chetwode.

On May 4 (1917) I received an intimation that I was to move over to East Force Headquarters and become Deputy Director of Medical Services of the Force.

(*To be continued.*)

Current Literature.

MM. de la Pradelle, Voncken and Dehousse. **La Reconstruction Du Droit de la Guerre.** Paris. Les Editions Internationales. Pp. 147.

This publication deals generally with the origin and activities of the International Congress of Military Medicine and other international bodies with similar interests and more particularly with certain important projects for the improvement of the laws of war by the inclusion of articles dealing with subjects now considered to be insufficiently covered, or which have hitherto been omitted from the International Code.

In the period 1914-1918 it was found desirable that the medical officers of the allied armies should meet and discuss the various problems then confronting them, and, arising from these conferences, in the years that have elapsed since the end of the Great War, an international medical organization has developed. The International Congress of Military Medicine and Pharmacy met for the first time in Brussels in 1921, and on that occasion a permanent committee was formed to arrange for future meetings. In 1930 a permanent record office was established at Liége. Behind this organization is the International Assembly of the heads of Naval, Military, and Air Force Medical Services a most important body which has been responsible for drawing up the statutes governing the work of the Congress, Committee and Bureau.

Since its formation the Congress has met eight times in different European cities, and the next meeting has been arranged to take place in 1937 at Bucharest on the invitation of the government of Roumania.

While the subjects discussed at these meetings have been largely of a technical and professional nature such as the treatment and evacuation of the sick, the wounded and gassed, the training and employment of specialists and similar measures designed to increase the efficiency of military medical services employed on what may be considered their normal duties, the publication under review shows that there has been for some years a very definite tendency to widen the boundaries of discussion and to deal with questions of social hygiene, physical training and similar subjects from the civil point of view, the competence of the military medical services to

advise and direct the authorities concerned in such matters being emphasized.

There has also been evident a growing conviction that as at present organized the medical services with an army in the field must be very largely ineffective under the conditions to be expected in a war of the future and an increasing realization that such wars will not only affect the fighting forces of the countries concerned but that attacks will be made on all centres of production and supply throughout their territories with the consequent wider spread of destruction and death involving to a very much greater extent than ever before the non-combatant members of their populations. In fact, there will be no area definitely recognizable as "the front" but practically only a "war area" co-extensive with the boundaries of the combatant States.

Having such considerations in mind the Congress at its seventh meeting at Madrid in 1933, prepared certain resolutions dealing with measures for the greater safety of military hospitals and for the protection of civilians, and copies of these were forwarded to all governments.

Impressed with the importance of these resolutions the Prince of Monaco called a conference in December, 1933, with a view to further discussion. This conference included medical and legal experts. The first subject dealt with was a proposal that owing to the great dangers of bombardment to which medical units will be exposed special areas should be definitely reserved for them under the protection of the Red Cross. A report by Colonel Voncken served as the basis for discussion and opened with a brief historical review in which it was pointed out that at the battle of Dettingen in 1743 the French and English commanders agreed to hold the hospitals immune from attack, the comment being made that while the humanitarian spirit then shown still exists the evolution of the machinery of destruction has been very rapid but there has been no corresponding development of the methods of protection of the sick and wounded. The provision of reserved areas for hospitals may offer a partial solution, although there may be difficulties in putting such a plan into operation, especially in the forward areas. Even there, however, if the places selected are not of strategic importance it will be possible to develop "hospital villages" in tents or huts. The main development of the scheme will, however, be the creation of large medical centres in distant towns, the range of modern transport rendering this feasible. Towns for use in this way should be selected and prepared in times of peace, and it is suggested that those likely to be found most suitable are spas and health resorts generally, then residential towns or those without industries likely to be of use in war and lastly those towns, chiefly on the sea coast, at the end of railway lines. In the case of these last, however, it may be necessary to ensure that the reserved area is not too large nor capable of being utilized as a landing place by enemies who do not respect conventions.

At "hospital towns" in the interior it is desirable that the railway station and a stretch of line on each side of it should be in the reserved area and that a deviation should be provided to carry military traffic.

These "hospital towns" must be completely demilitarized except that they should be administered by military medical personnel possibly supplied by neutral nations. A purely medical control will ensure that the sanctity of the Red Cross is respected and, if neutrals are in charge, any failure to do so will be liable to be immediately punished by the withdrawal of the neutral medical assistance.

The employment of neutral non-combatant assistance was also the subject of a report by Colonel Voncken to the Monaco Conference. In it he deplores the small progress made during the past two hundred years in the methods of alleviating the suffering caused by war and considers that one of the main requirements in the future will be a very considerable increase in the numbers of medical units available for use in the war areas. He considers that under the conditions likely to exist the complete medical personnel, both civil and military, of the nations involved will quickly be swallowed up in the military organization and that to fill up gaps in this and to provide for other essential medical requirements it will be necessary to obtain the assistance of the military medical services of neutral nations. To provide such assistance when required it follows that all military medical establishments must be fully trained, well organized and always ready to take the field in such strengths as may be agreed to by the signatory nations.

A third subject discussed at this conference was the care of prisoners of war. The existing convention admits of periodic visits of inspection of neutrals to prisoners' camps, but it was considered that this arrangement is capable of being greatly improved if provision is made for the complete medical care of prisoners to be in the hands of neutral medical services. It is felt that continued care and supervision of this nature would render impossible any repetition of the horrors and suffering which frequently occurred in these camps during the Great War.

The fourth main subject on which it is suggested that a new international agreement is required is the protection of the civil population, and a report by Major Reynders provided the basis for discussion at Monaco. In it the author points out that, in a war where many of the main strategic points are those towns in the factories of which are prepared the munitions of war, it must be expected that attacks on such points will be frequent and severe and, just as an army is organized and trained, so must these towns be prepared for war. To this end the public must be educated and accustomed to the idea of war and all that it may mean for them. First aid, and transport organizations must be formed and hospitals prepared, selected people being trained in peace time for the duties connected therewith. Should such an industrial town be exposed to bombardment or air attacks it will be impossible to guarantee the immunity of hospitals in it,

and it follows that these must be provided in "reserved areas" situated at a safe distance in the surrounding country. It is also suggested that for all that part of the population—the aged, the infirm, women and children —who can take no part in the industries of the town or in the work of the organized services a scheme should be drawn up providing for their evacuation to certain towns or localities previously notified as sanctuaries and which would be recognized by the belligerents as immune from attack.

The aim of the Monaco Conference was to bring international agreements more into accord with the conditions to be expected in future wars and the medical and legal experts there assembled ended their labours by preparing a series of articles embodying in practical form the conclusions reached and which they recommended for adoption.

The book goes on to discuss the present international code as defined by the Geneva Conventions of 1864 and 1906 and the Conventions signed at the Hague in 1899 and 1907, the relation of the League of Nations to these questions and the compatibility of the Articles framed at the Monaco Conference with existing agreements, the conclusion being reached that the articles proposed must form the basis of a new convention the ratification of which is a very urgent necessity admitting of no delay.

This rough outline gives but a scant idea of the evolution of the Monaco project and the amount of careful discussion and scrutiny to which every one of the proposals has been subjected. It is to be hoped that the valuable work carried out by all the organizations concerned in their initiation, construction and criticism will not be lost, and that the proposals so wisely conceived and soundly drafted may be fitted into the framework of international law before any further outbreak of war takes place. War has at all times been cruel but under modern conditions it has become a thing of such ruthless horror that it should be the object of everyone to assist in the forwarding of any schemes for lessening the suffering it entails especially among that large part of a population that must inevitably be passive spectators and only too often helpless victims of its blind brutality.

WIDDOWSON, E. M. & MCCANCE, R. A. **Iron in Human Nutrition.** *J. Hygiene.* 1936, v. 36, 13-23. [25 refs.]

The intake of inorganic or available iron is of far greater nutritional importance than the intake of total iron, as some iron is combined with pyrrole derivatives and is not set free by digestive juices. The present investigation consisted of assessing the total and available iron intakes of sixty-three men and sixty-three women ranging in age from 18 to 90 years, living on freely chosen diets. The mean daily value for total iron was 16·8 milligrammes for men and 11·4 milligrammes for women, but 30 per cent of the women were below 10 milligrammes a day. This difference was due to a lower consumption of total food and especially of meat. The available iron intake averaged 10·8 milligrammes a day for men (64 per

cent of the total) and 7·9 milligrammes for women (76 per cent of the total). When large amounts of meat are eaten, the available iron is less than half the total iron, but if the diet is mainly vegetarian, 90 per cent of the iron may be available. No significant correlation could be found between total or available intake and Hb. level. The effect of large doses of Fe (100 milligrammes of iron a day as ferrous sulphate or ferric ammonium citrate) scarcely altered the Hb. percentages of men (normal average being 103 per cent), but raised the value for women (original average 93 per cent) by 4 to 17 per cent.

DOUGLAS C. HARRISON.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 8.

LEONHARDT, L. Ueber eine Massenerkrankung an bakterieller Lebensmittelvergiftung. Entenei und *Bac. enteritidis* Breslau. [**An Outbreak of Food Poisoning Due to Bacteria. Ducks' Eggs.**] *Offentl. Gesundh. Dienst.* 1936, v. 2, A.9-12.

The author gives particulars of an outbreak of food poisoning of sixty-six cases with six deaths. All started with severe diarrhœa and vomiting followed by shivering and fever. Some, however, ran a prolonged course closely resembling typhoid fever. The incubation period in most cases was six to twelve hours. All the sufferers had eaten on July 29 the same midday meal at an hotel. The vehicle of infection was a pineapple preparation which contained ducks' eggs, and everyone who ate this food was ill. From the excreta of cases, the spleen of one of the patients who died, from the pineapple food and from one duck's egg, the same bacillus was isolated. The author describes it as *Bac. enteritidis* Breslau, but not typical as regards its agglutination characters [obviously a Salmonella strain but not fully identified by the agglutination tests quoted]. There were two cases of contact infection, guests at the same hotel. In the prolonged infections blood examinations were negative.

W. G. SAVAGE.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 8.

v. GAGYI, J. Ueber die bactericide und antitoxische Wirkung des Vitamin C. [**The Bactericidal and Antitoxic Properties of Vitamin C.**] *Klin. Woch.* 1936, v. 15, 190-95. [48 refs.]

It has previously been shown that ascorbic acid soon deprived diphtheria toxin (*in vitro*) of its lethal and antigenic properties. In the present work its action on several types of bacteria (including diphtheria, streptococcus, pneumococcus, the Salmonella group) was studied. Ascorbic acid (0·2 per cent) with the organisms suspended in saline was used. Other media were excluded owing to the tendency of many substances to oxidize vitamin C. Most bacteria did not survive the action of ascorbic acid indefinitely but the most virulent pathogenic types showed the greatest

sensitivity to its action. Speaking generally, the degree of sensitivity and the power to destroy vitamin C ran parallel. During the convalescent stage of diphtheria the bacillus gradually lost both these properties. It is not clear why vitamin C kills more readily the more virulent bacteria. Evidence was obtained that its lethal effect was probably due to its reducing power and not to the acidity of the medium. It was shown that heat-killed bacteria also destroyed vitamin C, and also that where diphtheria bacilli were not left long enough in contact to be completely killed, their virulence was greatly reduced. Tubercle bacilli after seventy hours of this treatment remained unaffected. It is suggested that vitamin C is a prophylactic against infection because it restrains the growth of bacteria. In the presence of active infection it tends to destroy the toxin and to reduce the virulence of bacteria. The lack of development of vitamin C in infectious disease is due to the power of bacteria to fix and destroy the vitamin. The therapeutic use of vitamin C in certain infections appears to be indicated on theoretical grounds. The best time and method for its administration are points which have still to be elucidated.

H. N. H. Green.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 8.

Reviews.

The Modern Treatment of Burns and Scalds. By P. H. Mitchiner, F.R.C.S. Pp. x + 62, with 12 plates. Size $5\frac{1}{2} \times 8\frac{1}{2}$. London: Baillière, Tindall and Cox. Price 5s.

This excellent little book may be confidently recommended as a clear and concise account of the modern treatment of burns and scalds. The extensive experience of the author has enabled him to include many very valuable practical suggestions which the busy practitioner will much appreciate. It is an able exposition of the value of the tannic acid compress which in the author's hands has proved such a safe satisfactory and comfortable dressing for all burns and scalds. B. B.

Physical Signs in Clinical Surgery. Fifth Edition. By Hamilton Bailey, F.R.C.S.Eng. Bristol: John Wright and Sons, Ltd. 1935. Pp. xii + 287. Price 21s.

The fifth edition of this somewhat unusual work has been fully revised and enlarged. It contains a description of practically all the recognized signs used in clinical surgery. After a full description of the basic physical signs, and the general signs of tumours, ulcers, fistulæ and cellulitis, the body is dealt with systematically. All the descriptions given are

remarkably clear and full, and the majority of the clinical tests are illustrated by photographs and diagrams. The number of illustrations both of clinical tests and pathological conditions is most remarkable, and their excellence makes the whole work one of great interest. Though perhaps primarily a book for the advanced student, it is also invaluable for any medical man who may have been absent for a period from actual clinical work. G. T. G.

THE NATURAL HISTORY OF DISEASE. By John A. Ryle, M.A., M.D., F.R.C.P. Oxford University Press. London: Humphrey Milford. 1936. Pp. x + 438. Price 15s.

This is a book for the clinician which embodies many interesting observations upon disease which do not appear in ordinary textbooks on medicine.

Dr. Ryle has given us an interesting study of many different clinical conditions. Among those which are particularly useful are the chapters upon Staphyloccoccal and Streptococcal Fevers and upon the Visceral Neuroses. These are but examples from a volume which will be welcomed by every medical man. J. H.-S.

A HANDBOOK OF SURGERY. By Eric C. Mekie, M.B., Ch.B., F.R.C.S.Ed. With a foreword by John Fraser, M.C., M.D., Ch.M., F.R.C.S.E. Edinburgh: E. and S. Livingstone. 1936. Pp. xii + 699. Price 12s. 6d. net.

The author in his foreword clearly defines his object as being "To set down only what are the salient features of the subject which must be known ere the student presents himself for examination," and adds that "all that is non-essential to the task of surmounting the final hurdle of the medical undergraduate career is excluded."

Mr. Mekie has produced a handbook that fulfils his object and which can be recommended to those for whom it was written.

Messrs. Livingstone have published the book in a convenient form.

D. C. B.

POST-GRADUATE SURGERY. Vol. I. Edited by Rodney Maingot. London: Medical Publications, Ltd. 1936. Pp. xvi + 1742. Price 70s. net per volume. (£9 9s. three volumes.)

This is the first of three volumes on practical surgery written specially for post-graduates.

There are twenty contributors to this volume, which is a massive one of 1742 pages.

The contributors are surgeons whose work is well known and authoritative in the surgical world—the aid of the physicians has also been called

in, for there are articles on investigation of a case of dyspepsia, diabetes in surgical cases, hæmatemesis, and other problems connected with surgical cases.

Part I gives an account of the usual forms of anæsthesia, with indications for their use, by C. Langton Hewer.

Part II consists of fourteen sections on abdominal surgery by various authors.

The descriptions of operations are most helpful and well illustrated—among these we may notice an account of the Péan-Billroth operation by Enrico Finochietto—also an article on Egyptian Splenomegaly by H. E. S. Stiven.

Post-operative management and complications are discussed and there are also nine short chapters by the editor on complications following abdominal operations.

Part III deals with diseases of the rectum and anus by W. E. Miles.

Part IV is concerned with X-ray diagnosis by H. C. Bull, with sections on the radiology of the alimentary and urinary tracts.

Part V comprises radium treatment by Stanford Cade and Malcolm Donaldson.

The main object of this work appears to be to give everything connected with a surgical case—investigation, indications for operation, operative details, complications and after-treatment—in one compass, and so obviate the necessity of searching through many books. This is an excellent idea and should be more than useful to those who practise surgery in distant countries where the resources of medical libraries are not available.

The editor, contributors and publishers are to be highly complimented on their achievement, and we look forward with interest to the other two volumes.

J. M. W.

POST-GRADUATE SURGERY. Vol. II. Edited by Rodney Maingot. London: Medical Publications, Ltd. 1936. Pp. viii + 1825. Price 70s. net per volume. (£9 9s. three volumes.)

This is the second volume of the three in the series; another massive one of 1825 pages.

Part VI begins with head injuries and intracranial tumours—the spinal column and salivary glands, by C. P. G. Wakeley. The technique of operations on the brain is included and there is a separate chapter on trigeminal neuralgia.

Part VII, by Sir W. I. de C. Wheeler, deals with the surgery of the neck. The technique of colonic oil-ether anæsthesia is given at length, as the writer states that "there is not sufficient acquaintance with the modern methods of administration."

Part VIII, by R. J. McNeill Love, deals with the breast. A very clear account is given of the radical operation for carcinoma.

Part IX is devoted to the thorax, and is divided into two sections: (1) Medical conditions, by R. Sleigh Johnson, consisting of post-operative chest complications and artificial pneumothorax; and (2) surgery of the thorax, by T. Holmes Sellors, including the surgical treatment of pulmonary tuberculosis, acute empyema, chronic empyema, tuberculous empyema, pulmonary embolism, intrathoracic tumours and bronchiectasis.

Part X deals with the female genital organs. Section 1, Regional Gynæcology, is by J. Lyle Cameron; Section 2, Gynæcological Operations, by the same author; Section 3, on Sterility, by S. Forsdyke; and Section 4, on the Ovary, by V. B. Green-Armytage. This is a very comprehensive part consisting of 470 pages, and the subject is gone into in great detail. The operations are very clearly described with numerous excellent illustrations.

Part XI, by J. C. Ainsworth-Davis, deals with the urinary system and male generative organs. This is a long and very complete section of 430 pages.

Part XII is a most interesting and useful section on the sympathetic nervous system, by A. Lawrence Abel—a most complete account, giving an excellent description of the anatomy and pathology, the sympathetic diseases of various organs and the surgical treatment.

Part XIII deals with the adrenal gland. Section 1, the surgery of the adrenal gland, by L. R. Broster; and Section 2, the surgical pathology, by H. W. C. Vines.

Part XIV deals with injection therapy. Hernia is by St. George B. Delisle Gray; hæmorrhoids, by R. Simpson Harvey; hydrocele and varicocele, by Rodney Maingot; and varicose veins, by R. Simpson Harvey.

It is a little surprising to see that the injection treatment of hernia is regarded as on the same basis as that of the other conditions.

Part XV is on that most important subject, infections of the hand, and is excellently written by Hamilton Bailey.

Part XVI is on orthopædics, and written by Lt. J. D. Buxton. This is a slightly unusual but excellent arrangement and includes chapters on acute osteomyelitis; acute arthritis and open fractures as well as deformities of the feet; disabilities of the knee-joint and muscle and tendon injuries. The part concludes with a short chapter on the Surgery of the peripheral nerves.

J. M. W.

Notices.

LEUCARSONE.

THIS drug is manufactured by Messrs. May and Baker, Ltd. It is P-Carbamino-Phenylarsonic Acid containing approximately 29 per cent of arsenic (Carbarsone). It is used in the treatment of amœbic dysentery, colitis, and other intestinal infections.

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Material should be given with all available details in regard to source, diagnostic symptoms and the name and address of the person or persons who vouch for accuracy. All such details will be regarded as strictly confidential.

Reprints of published work would be most acceptable. Further, many authors when publishing material may also have collected a number of pedigrees which they have been unable to reproduce in detail. It is the object of the Council that such records, by being included in the Clearing House, should not be lost.

Those wishing for a copy of the Standard International Pedigree Symbols may obtain one from the office.

Announcements in regard to the services undertaken by the Bureau will be published from time to time.

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HEALTH CONGRESS, 1937.

The Council of The Royal Sanitary Institute have accepted an invitation from the Birmingham City Council to hold the Health Congress at Birmingham from July 12 to 17, 1937.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

Correspondence on matters of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a nom-de-plume.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts in the case of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

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Communications in regard to editorial business should be addressed—"The Editor, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, War Office, Whitehall, London, S.W. 1."

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VOL. LXVII NOVEMBER, 1936. No. 5.

Journal
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Original Communications.

BACT. KIRKEE: A NEW SALMONELLA TYPE.

By LIEUTENANT-COLONEL R. F. BRIDGES
AND
LIEUTENANT-COLONEL L. DUNBAR, O.B.E.,
Royal Army Medical Corps.

From the Enteric Laboratory, Kasauli, and the Southern Command Laboratory, Poona.

ON leaving England for his present tour of foreign service, one of us remarked jokingly to a friend that he intended to name a new organism of the Salmonella group after every military station in India. He was too boastful. It is true that within a fortnight of landing in the country a new type came to hand. It had been isolated in Poona, and has already been described under the name *Bact. poonæ* in the pages of this Journal (Bridges and Scott, 1935). Certain strains from other stations have also been examined, showing minor serological differences from accepted type strains. But it is doubtful whether these should be regarded as new types, rather than as varieties of those already described. It has been necessary to wait a further three years before another organism has appeared, which can definitely takes its place in the Kauffmann-White scheme as a new Salmonella type; and again the organism was isolated in the Southern Command Laboratory, Poona.

It is customary to name new Salmonella types after their place of origin, but no difficulty arises in connexion with the nomenclature of the present strain, since the patient, under the care of his parents, was resident in Kirkee and contracted his illness in that station. Kirkee is an outlying

portion of Poona, about three miles distant from the main cantonment. Specimens from the case were sent to the Command Laboratory at Poona for examination. The name Kirkee is therefore suggested for the organism described in this paper.

Source of the Strain.—The circumstances under which *Bact. kirkee* was isolated were very similar to those found in connexion with *Bact. poonæ.* Again the patient (P. M.) was a child—an infant aged 10 months—suffering from diarrhœa of dysenteric type. The onset was sudden on the morning of September 2, 1935, with fever rising to 102° F. in the evening, and accompanied by fluid diarrhœa, seven or eight stools being passed during the twenty-four hours. The motions soon showed flakes of blood-streaked mucus, but on the second day became rather greenish in colour and less frequent. The fever, however, persisted.

By the morning of the third day the fever had subsided and the stools had returned to normal. The child was happy, took its feeds well, and thereafter made an uneventful recovery.

During the acute phase milk feeds were curtailed, but not stopped, and were supplemented by alkaline glucose solution in the form of raisin tea. Grey powder was administered from the beginning, half a grain night and morning for nine doses. Normal feeds were resumed on the morning of the third day, when all symptoms had subsided.

As regards the possible source of infection, it is of interest that an Alsatian dog kept in the house was said to have suffered from diarrhœa with blood-stained stools one week before the child became ill. Unfortunately this information was only elicited some time after the patient had recovered, and it was not then possible to make any examination of the dog's blood or fæces.

Isolation of the Strain.—A greenish stool, passed on the second day of illness, was sent to the laboratory for examination. Flakes of mucus were picked out and were found to give an alkaline reaction to litmus. They showed an exudate, microscopically typical of bacillary dysentery.

Platings of the mucus were made on litmus lactose bile-salt agar. After twenty-four hours' incubation the plates showed a few non-lactose-fermenting colonies, which were slightly opaque and not quite typical of the dysentery groups. Several of the colonies were selected for examination, but all showed the same characters. The organism was a Gram-negative motile bacillus giving biochemical reactions of the Salmonella group. It was agglutinated to the full H titre of a serum prepared from *Bact. paratyphosum* B, but showed no agglutination when tested with the serums of Para A, Para C, Aertrycke, Newport and Enteritidis.

As a result of these tests it was at first thought that the organism was identical with *Bact. paratyphosum* B. Further tests, however, showed that alcoholized suspensions of the strain were inagglutinable with Para B serum, a fact which suggested that in its somatic antigen the organism must differ from a normal strain of *Bact. paratyphosum* B. This was confirmed later,

when a serum prepared from the new strain was found to have no agglutinating effect on alcoholized suspensions of Para B. It thus became clear that we were dealing with a new Salmonella type, which must be set aside for more rigid investigation.

Biochemical Reactions of Bact. kirkee.—The organism was tested in "sugar" media and also in regard to its production of H_2S, and the results were compared with those given by a number of strains of *Bact. paratyphosum* B and its varieties. These results are shown in Table I. Among the strains used for comparative tests were two laboratory stock cultures of Para B—the one labelled "stock," which had been present in the laboratory for many years and of which the origin is unknown; the other labelled "Topley," and obtained from the Oxford Standards Laboratory some years ago. In addition, four strains were tested which had been isolated in India during the last few years and are known by their index numbers. Lastly, four strains were examined which had been received from Java and are of the kind described by de Moor (1935). The peculiarity of these Java strains and the point in which they differ from a normal Para B, is that they are monophasic. They agree with Para B in their somatic antigens and in the specific phase of their H antigens, but they are deficient of group phase in the H antigen.

TABLE I.

Organism	Glucose	Maltose	Mannite	Dulcite	Rhamnose	Arabinose	Xylose	Inosite	Sorbite	H_2S.
Kirkee ..	AG	AG	AG	AG	AG	AG	AG	—	AG	+
"Stock" ..	AG	AG	AG	AG	AG	AG	AG	AG	AG	+
"Topley" ..	AG	AG	AG	AG	AG3	AG	AG	AG	AG	+
10/33	AG	AG	AG	AG	AG	AG	AG	AG	AG	+
252/34	AG	AG	AG	AG	AG	AG	AG	—	AG	+
5/36	AG	AG	AG	AG	AG5	AG	AG	AG	AG	+
10/36	AG	AG	AG	AG	AG3	AG	AG	AG	AG	+
Java, 12,808 ..	AG	AG	AG	AG	AG	AG	AG	—	AG	+

It will be seen in Table I that the only sugars which might have any differentiating value were rhamnose and inosite. In the case of rhamnose there were slight differences observed in the time required for this sugar to be attacked. But after five days incubation acid and gas were present in all tubes.

In the case of inosite this sugar was fermented by both the stock cultures and by three out of the four locally isolated strains. On the other hand one local strain, No. 252/34, the four Java strains (only one is shown in the table) and *Bact. kirkee* failed to ferment this sugar. The fact that this Java variety of *Bact. paratyphosum* B does not ferment inosite has been pointed out by de Moor, and as a loss-variant this can be understood; but no reason can be given for the failure to do so in the case of the local strain 252/34, since no serological difference can be discovered between this organism and a normal strain of Para B.

Serological Reactions of Bact. kirkee.—The flagellar antigen of *Bact.*

kirkee can be disposed of in a few words. The organism readily yielded type and group phases, which were found to be identical with those of *Bact. paratyphosum* B. Cross-absorption tests were carried out with mixed-phase serums of Kirkee and Para B having homologous type and group titres of about 10,000 in each case. The serum of the one organism was absorbed first with the type phase, and in a second test with the group phase of the other, and the absorbed serum was then tested for the presence of homologous type and group agglutinin. The serum of the other organism was then treated in like manner. In all tests complete removal of the absorbed agglutinin was noted, proving that mirror identity exists between the flagellar antigens of *Bact. kirkee* and *Bact. paratyphosum* B in both type and group phases.

It is by the nature of its somatic antigen that *Bact. kirkee* claims recognition as a new Salmonella type. Tests have shown that this antigen differs not only from that of *Bact. paratyphosum* B, but also from those of any known Salmonella.

TABLE II.

1	2	3	4	5	6
Antigenic group	Representative organisms	Somatic antigenic elements present in representative organisms	Homologous titres of serums prepared from representative organisms	Titres against *Bact. kirkee* of serums prepared from representative organisms	Titre of Kirkee serum against representative organisms
A	Paratyphosum A	I II	2,000	Nil	Nil
	Senftenberg, var. Newcastle	I III	1,200	Nil	Nil
B	Paratyphosum B	IV V	1,200	50	50
	Aertrycke		1,400	Nil	Nil
	Derby	IV	1,500	Nil	Nil
C	Paratyphosum C	VI VII	400	Nil	Nil
	Bareilly		3,000	Nil	Nil
	Newport	VI VIII	2,000	17	Nil
D	Typhosum	IX	10,000	100	50
	Enteritidis, var. Dublin		1,500	Nil	Nil
E	London	X III	3,000	Nil	Nil
F	Aberdeen	XI	5,000	175	Nil
G	Anatum C.I.	XII III	2,500	Nil	Nil
H	Poona	XIII	250	Nil	Nil
I	Kirkee	XIV	3,000	3,000	3,000

When it is required to test the somatic antigen of an unknown organism belonging to the Salmonella group, it is unnecessary to employ serums prepared from every one of the forty and more types which now constitute the group. In many cases, while these organisms may differ completely in their flagellar antigens, yet they are identical with others in their somatic elements. Hence it has been possible to arrange the organisms of the

group as a whole into a number of smaller groups, lettered A, B, C, etc., according to the nature of their somatic antigens. In testing an unknown organism, therefore, it is sufficient to choose representative organisms from each of the groups and to carry out agglutination tests, and absorption tests if necessary, between the unknown strain and the representative type organisms. In this way the work is very much simplified.

Reference may now be made to Table II. In this table, column 1 shows the groups lettered from A to I, while column 2 shows the organisms which have been chosen in the present investigation as representatives of these groups. Column 3 gives the somatic antigenic elements present in each of the representative organisms; and it will be noted that these factors, even among organisms included in the same group, are not in all cases identical. Thus, group A contains both *Bact. paratyphosum* A and *Bact. senftenberg*, and it will be noted that while the somatic antigen of Para A is represented as I II, that of Senftenberg is shown as I III. Further, it will be seen that the factor III is also present in the London type of group E, and in the Anatum C.I. type of group G.

Column 4 shows the homologous titres of the serums prepared from the representative organisms, and column 5 the titres observed when these serums were tested against *Bact. kirkee.* Column 6 gives the results obtained by testing the serum prepared from *Bact. kirkee* against suspensions of the representative strains. It should be said that in all these tests alcoholized suspensions were used, so that the figures indicate O agglutination only, even though the serums contained both H and O agglutinin.

One other matter of importance must be mentioned. It should be understood that groups F, G, H and I, and the antigenic elements present in the representative organisms of these groups, are not yet officially recognized. They are only shown in Table II for the sake of completeness. At the last sitting of the Salmonella Subcommittee (1934) of the International Society for Microbiology, the organisms Aberdeen, Anatum C.I., Poona, and of course Kirkee, had not been identified, and hence could not come under the notice of the Subcommittee. It is more than probable that some regrouping will be necessary before these organisms can be allotted their final places in the Kauffmann-White scheme. Thus, it is known that there are already rival claimants to the factor XII. Moreover it is possible that before the publication of this note the factor XIV, which has been assigned in Table II to *Bact. kirkee* will have been annexed by some other organism. The final grouping, therefore, must await the decision of the International body.

Table II shows in columns 4 and 5 that serums prepared from organisms representing the different somatic antigenic groups, and having homologous O titres ranging from 250 to 10,000, had either no, or at most slight, agglutinating effect on the O antigen of *Bact. kirkee.* Column 6 shows that the serum prepared from *Bact. kirkee* had little action on the somatic antigens of the representative organisms. These tests clearly place

Bact. kirkee in a group by itself, to which the letter I has been assigned in the table, the somatic antigen being represented by the factor XIV.

It seemed advisable to carry out absorption tests between *Bact. kirkee* and those organisms with which it showed slight cross-agglutination, in order to determine how far community of somatic antigen might be present. These tests are detailed below and are expressed in the form of equations. The serum, with its homologous O titre in brackets, is placed first. This is followed by the organism used for absorption, preceded by the minus sign. The suspension against which the serum was tested after absorption and the titre obtained are then shown.

In all these absorption tests five drops of serum were absorbed with the growth from one Roux bottle. Alcoholized suspensions were used for test of the serums after absorption. The lowest dilution tested was 1 : 50.

Kirkee	(2,500)	– Kirkee	v.	Kirkee	=	Nil
,,	,,	– Para B	v.	,,	=	2,000
,,	,,	– Typhosum	v.	,,	=	2,200
,,	,,	– Aberdeen	v.	,,	=	1,750
Para B	(1,200)	– Kirkee	v.	Para B	=	1,000
Typhosum	(2,000)	– ,,	v.	Typhosum	=	2,000
Aberdeen	(3,500)	– ,,	v.	Aberdeen	=	2,500

SUMMARY.

A new Salmonella organism is described, for which the name Kirkee is proposed. Subject to reservations given in a previous paragraph, its antigenic formula may be expressed as follows :—

Somatic antigen	Flagellar antigen	
	Type phase	Group phase.
XIV.	b.	1.2.

The organism was isolated from a mild case of acute enteritis in an infant. The suggestion is made that infection was conveyed from a dog.

The strain has been deposited with the National Collection of type cultures in the Lister Institute, London.

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A LIMITED OUTBREAK OF DIPHTHERIA EXHIBITING BOTH CUTANEOUS AND FAUCIAL LESIONS.

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Introduction.

CUTANEOUS diphtheria is a condition that has been known to exist for many years. In 1906 Hammerschmidt described skin lesions from which virulent diphtheria bacilli had been isolated and since that date there have been numerous references in the literature to these extrafaucial localizations of *Corynebacterium diphtheriæ.* In some cases, however, there is no record of the virulence of the organism isolated and, as avirulent diphtheria-like bacilli are not uncommonly found on healthy skin, the significance of some of these reports must remain in doubt. Nevertheless the virulence test was carried out by some of the early workers and the isolation of virulent *C. diphtheriæ* from cutaneous lesions was reported by Gunther (1907), Dawson (1910), and many others.

The majority of these descriptions refer to isolated cases, but during the Great War the diphtheritic infection of wounds was not uncommon and more than one series was published. In a military hospital in Toronto Fitzgerald and Robertson (1917) investigated an outbreak where some forty patients were found to have wounds infected with *C. diphtheriæ*, the organisms proving to be virulent when inoculated into guinea-pigs. The origin of this outbreak was by no means clear; one of the nurses dressing the cases had a small diphtheritic lesion on one of her fingers and was thought to be responsible to a certain extent. Douglas, Fleming and Colebrook (1920) also reported a series of cases. "Wound diphtheria," described in Germany just after the Great War by Weinert (1919), Nieter (1919) and others, was a very common condition, but owing to the fact that virulence tests were carried out on only a small proportion of the organisms isolated it is not possible to say whether the infection was always a true diphtheritic one.

Manson-Bahr (1929) mentions the work of Craig in Palestine, who isolated diphtheria bacilli from many cases of desert sore and frequently observed typical post-diphtheritic paralyses as complications of the condition. Manson-Bahr also describes his own experiences there and pertinently notes that these diphtheritic sores were associated with a widespread epidemic of faucial diphtheria. Rolleston (1936) in discussing cutaneous diphtheria mentions paralyses as not uncommon complications and further, with regard to the importance of the early recognition of such lesions, says: "Subjects of clandestine diphtheria like clandestine prostitutes are

of considerable epidemiological importance, as both, owing to their innocent appearance may widely spread disease before their true nature is recognized."

History of the Outbreak.

The present communication is concerned with a limited outbreak of diphtheria, both faucial and cutaneous, that occurred during the North-West Frontier Operations in the autumn of 1935. The ground in this area is extremely rocky and there were very few of the troops employed who did not sustain some sort of abrasion in climbing up or scrambling down the steep rock-strewn khud-side. Although these wounds, for the most part, appeared to be trivial it was noted in one battalion that not only was healing not induced in some individuals by the usual treatment but that the lesions became progressively more extensive. That this non-healing did not attract attention earlier may be explained by the fact that a condition, very similar in appearance, is common in this area. It develops from a simple abrasion and is often very slow to heal. The ætiological agent in the majority of cases appears to be a staphylococcus, but it is probable that several factors are responsible for the slow healing. The lesion is often referred to colloquially as "Frontier Sore," but is not to be confused with the Leishmania infection that on occasions has been known by that name.

The first case seen by the writer in this outbreak was one of extensive ulceration of the calf of the leg from which an almost pure culture of *C. diphtheriæ* was obtained. It was not possible, however, to say when the diphtheritic infection was superimposed as forty days had elapsed since the original abrasion had been sustained. It was known that there had been several cases of sore throat amongst the troops, and two cases of faucial diphtheria had been evacuated from a neighbouring battalion, but at this distance of time it was not feasible to trace accurately the individual movements of troops.

By the beginning of November the force that had been engaged in the operations was moving back, and two cases of faucial diphtheria were discovered in the battalion under review whilst on the line of march. Then, as a result of the bacteriological examination of the skin lesions of all the patients in hospital eight further cases of cutaneous diphtheria were diagnosed in the same battalion. These patients had all sustained abrasions in the same area of field operations, but it was by no means clear that all the wounds were infected with *C. diphtheriæ* when the patients were admitted to hospital. Indeed, it has been proved that one case was due to a cross infection in the ward.

It may be noted here that repeated throat swabs were taken from all these cases with cutaneous lesions, but the cultures failed to show any diphtheria bacilli.

Although the cases so far noted had belonged to a single battalion it

was decided to carry out a very careful examination of all the troops who had been engaged in the same area, paying special attention to the battalion already attacked. The general examination consisted in a careful skin inspection of all troops and followers. Every cutaneous lesion was examined bacteriologically, and if the wound was at all indolent the examination was repeated until signs of healing were obvious. Several of these re-examinations revealed the presence of diphtheria bacilli when the original culture was negative.

In addition, the battalion already attacked was subjected to a complete double throat swabbing; nasal swabbing was less complete. Owing to the exigencies of the Service the investigations had to be spread over a rather wider space of time than was ideal and involved the examination of over two thousand throat swabs and about four hundred wound swabs.

Table I shows the results obtained from the examination of the swabs from the wounds.

TABLE I.

	Number of swabs examined	Number of cases harbouring *C. diphtheriæ*
X Battalion	246	31
Other Troops	152	Nil

It will be seen from the above table that whilst many other individuals were suffering from slowly healing abrasions, only those from the X battalion were found to be harbouring *C. diphtheriæ*. It is true that one

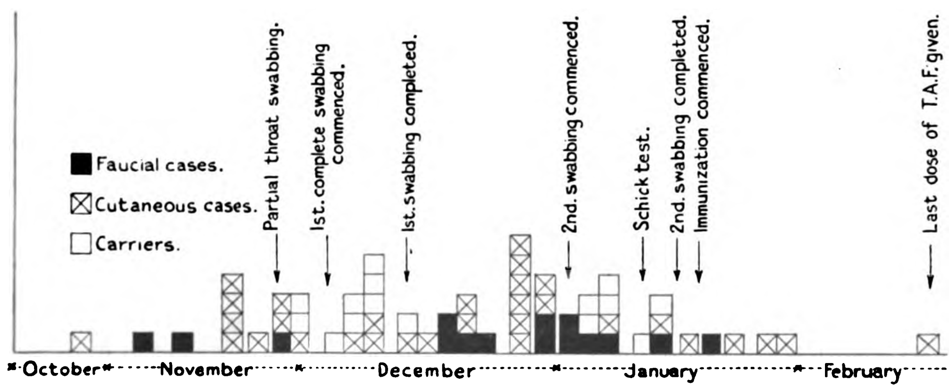

CHART I.

case of cutaneous diphtheria was discovered in a soldier belonging to another battalion, but that case occurred in hospital and was proved conclusively to be due to a cross infection in the ward.

Chart I shows the distribution of all the cases, both faucial and cutaneous, and also the carriers of virulent diphtheria bacilli as they were spread over

the period under review. As will be observed, cases of cutaneous diphtheria and virulent throat carriers continued to be discovered over a prolonged period. But what is more important, typical faucial diphtheria began to occur in December and continued throughout January.

Although the carriers were isolated immediately they were discovered cases continued to occur and, as the second series of throat swabbings yielded six more carriers, it was probable that even after a third swabbing every carrier might not have been found. It was felt, therefore, that more active steps should be taken to attempt to limit the outbreak. Schick-testing material was obtained with the least possible delay and the immunity reactions of the whole of the affected battalion were investigated. The positive reactors were immunized with a suitable prophylactic as soon as they were observed.

The occurrence of cases became less and less but did not cease completely until some degree of immunity was established. The last case of cutaneous diphtheria was diagnosed on February 20 and since that date three months have elapsed and neither faucial nor cutaneous diphtheria has been seen in the battalion.

Description of the Cutaneous Lesions.

Although, as Rolleston (1936) says, these extrafaucial localizations of diphtheria may imitate almost any type of skin lesion, there was one variety that was almost pathognomonic. This was the deep punched-out ulcer with a thick unhealthy edge and with a floor covered with a dirty grey membrane that contained almost pure cultures of *C. diphtheriæ*. The ulcer had a fœtid odour and was seen in a considerable proportion of the established cases. These had been in existence for four or more weeks when seen and agreed with the chronic diphtheritic ulcer described by Manson Bahr (1929). The first case in the present series was of this nature. Some forty days had elapsed since the original injury—three small abrasions on the back of the leg—had been sustained. Three abrasions had ulcerated and the lesions had steadily increased in size until there was a single irregular ulcer five by three inches over the middle of the calf. The membrane contained almost pure cultures of diphtheria bacilli.

The more recently infected abrasions simulated a variety of skin lesions. One patient appeared to have an impetigo of the face, another an eczematous condition between the toes and yet another an oriental sore on the dorsum of the hand, but all varieties yielded cultures of *C. diphtheriæ*. These cases, without exception, responded to the specific treatment given whereas improvement had not followed any of the various local applications to the chronic ulcerations.

As would be expected the majority of the sores were on the hands and knees, although any situation where an abrasion existed was liable to become infected. The distribution of the lesions was as follows :—

Knee	..	..	..	12 cases
Hands and arms		..	..	10 ,,
Face	..	..	..	4 ,,
Heel ..	..	..	..	2 ,,
Toes ..	..	..	..	2 ,,
Ankle	..	..	..	1 ,,
Calf ..	..	..	..	1 ,,
Buttock	..	..	..	1 ,,
		Total	..	33* cases

* Two of the 31 patients, suffering from cutaneous diphtheria, had multiple lesions—hence the extra two cases.

Two of the patients with skin lesions were found to be suffering from mild faucial diphtheria also. They complained of a sore throat with some pyrexia and virulent diphtheria bacilli were recovered from the throat swab. There was no membrane over the fauces in either case and the signs and symptoms disappeared very quickly following the exhibition of specific treatment. In one of these cases the sore on the skin, an early lesion, and the throat condition were discovered within a day of each other, but in the other case the ulceration was well established before the faucial lesion was discovered. In view of the very transient throat condition it would appear that this individual had become partially immunized from the toxin absorbed from the ulcer. Both these cases occurred before the Schick-testing had been carried out and the first one was not sufficiently typical to show the progressive ulceration, but the second case showed this property very well so that there could have been but little antitoxin present in the patient's blood prior to infection.

Treatment of the Extrafaucial Lesions and Course of the Disease.

Although there was some slight variation in individual cases the same general plan of treatment was adhered to after the experience of the first few in the series.

Immediately a case was diagnosed cutaneous diphtheria 8,000 to 16,000 units of diphtheria antitoxin were administered by the intramuscular route and antitoxin was also applied locally as a dressing. The pure serum dressings were repeated daily for three days and the intramuscular antitoxin repeated on the third day. The exhibition of further antitoxin depended on the extent of the lesions and their response to treatment. The average amount of antitoxin injected in each case was about 30,000 units. After the third day the antitoxin used for the local treatment was diluted with equal parts of sterile normal saline.

In most cases there was an almost dramatic response to the treatment. The ulcers were clean by the fourth day, diphtheria bacilli could no longer be cultivated from the granulating surface and the edges showed signs of healing. The illustrations on page 300 show these ulcers in various stages of healing.

As soon as cultural examinations demonstrated that the wound was bacteriologically clean an elastoplast dressing was applied. Rapid healing

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

or early scabbing was not encouraged as it was found that diphtheria bacilli would sometimes flourish underneath a scab.

There were occasions on which, in spite of the early appearance of a healthy granulating surface, *C. diphtheriæ* persisted in the wound for a

considerable period. In these cases prolonged serum treatment, locally or by intramuscular injection, did not hasten the disappearance of the infecting organism. Various dressings were tried and the most successful appeared to be a preparation known as Mucidan (Paschlau 1935), which has been advocated recently for the treatment of diphtheria throat carriers. The formula is as follows :—

Formaldehyde		11 parts
Potassium sulphocyanide ..		2 ,,
Gelatine		15 ,,
Spirits of wine		15 ,,
Oil of peppermint		1 ,,
Distilled water ..	to	100 ,,

Generally the ulceration was well established before any specific treatment was given and healing was naturally slow. In the earlier series the average time for complete healing was nearly eight weeks from the commencement of the specific treatment. Although the healing was a slow process the scars were firm and showed no tendency to break down. In the later series in which a recently sustained abrasion had become infected with diphtheria bacilli healing was much more rapid and averaged about three weeks. The last case that occurred was that of a man who received a knock over the ankle whilst playing hockey. He had shown himself to be non-immune when Schick-tested and had already received one dose of prophylactic before the injury had been sustained. The ulceration was discovered to be diphtheritic on the day that the last dose of T.A.F. was being administered. The usual treatment was instituted and within forty-eight hours the wound was bacteriologically clean and closing in. By the eighth day healing was complete.

Complications.

In the series of cases under review complications of a serious nature were not seen. There were, however, five cases of post-diphtheritic paresis out of a total of forty-six.

Private L. ..	Faucial diphtheria	Palatal paralysis
Private M. ..	Faucial diphtheria	Paresis of ext. rectus ; tingling of fingers
Private P. ..	Cutaneous lesion (I.A.T. face)	Facial paralysis and tingling of fingers
Private H. ..	Cutaneous lesion (I.A.T. buttock)	Paresis of both legs
Private R. ..	Cutaneous lesion (I.A.T. knee)	Tingling of fingers and paresis of legs

Laboratory Investigations.

This work involved the examination of a very large number of field cultures on Loeffler's medium and it may be mentioned at this stage that

McCartney's screw-capped bottles, which are used extensively in this laboratory, proved superior in many ways to the test tube and flask.

All swabs, whether from skin lesions or from throats, were first planted on Loeffler's serum slopes and incubated for eighteen hours. A provisional diagnosis was made on finding diphtheria-like bacilli in field smears from these slopes stained with Loeffler's alkaline methylene blue. Every culture containing suspicious organisms was then subcultured on to "Tellurite" medium in order to obtain pure growths for the study of the colonial characters, the carbohydrate reactions and the virulence of the organism isolated. When these examinations had been completed a final report was rendered.

In all seventy-two strains of diphtheria-like bacilli were investigated, and, of these, sixty-five had all the characters of *C. diphtheriæ mitis*. There was in many cases a very slight reaction in starch which faded after the first twenty-four hours' incubation, and when this was compared with the marked reaction with all the known starch fermenters, used as controls, it was regarded as negative. The remaining seven strains were saccharose fermenters.

The intracutaneous virulence was employed as a routine, but the intraperitoneal test was used from time to time as a check. In the intracutaneous method six to eight strains, together with positive and negative controls, were tested on each pair of guinea-pigs used.

Of the sixty-five non-saccharose-fermenting strains, sixty-one proved to be virulent, and with these the degree of necrosis produced in the guinea-pig appeared to be the same with every strain. The seven saccharose fermenters all proved to be avirulent.

Type of organism	Faucial diphtheria	Cutaneous diphtheria	Healthy throats
C. diphtheriæ mitis –			
Virulent	15	31	15
Avirulent	0	0	4
Saccharose fermenters—			
Avirulent	0	2*	5

* Found during the examination of all skin lesions in other units.

Immunity Reactions.

Although Schick-testing has been carried out in India on previous occasions, there has always been a certain amount of hesitation in accepting the results as sufficiently accurate owing to the necessity of subjecting an unstable preparation to such varying temperatures during its importation. The weather over the whole of the air route in early January was moderately cool, and it was decided therefore to import Schick-testing material by air mail. The preparation was received in the laboratory on the ninth day following the order, and the testing of the whole battalion

commenced forthwith. For military reasons this had to be spaced out over a longer period than was ideal, and for the same reason the results could only be read on three occasions, viz.: after twenty-four hours, forty-eight hours, and five days. There was, however, little difficulty in recording the positive reactors. Out of a total of 197 non-immunes (27 per cent of the strength), the reactions of 119 were obvious on the first or second day, and 78 were only discovered during the final reading. It may be of interest to note, in view of the high percentage of positive reactors, that 102 (over 50 per cent) of these individuals came from small towns or villages in England.

Before immunity could be established four positive reactors developed cutaneous diphtheria, and two faucial diphtheria. Indeed, one of the faucial cases was a member of a batch of individuals who were swabbed and Schick-tested on the previous day. Twenty-four hours later the swab was positive, the skin reaction very marked, and the patient suffering from diphtheria.

Immediately the Schick-testing was completed one of the unopened bottles of the toxin was returned to the Wellcome Physiological Research Laboratories. Dr. O'Brien kindly tested this specimen after its journey of over 15,000 miles, and reported that the toxin was fully potent.

It would appear, therefore, that the results, recorded above, of the immunity reactions of the individuals under review are reasonably accurate.

	HQ. wing.	A.coy.	B.coy.	C.coy.	D.coy.
Percentage of Reactors.	26	21	31	32	22
Number of Cases	5	5	16	11	7
Number of Carriers.	2	2.	5	1	5

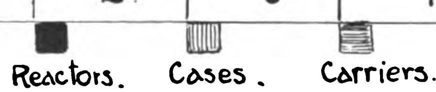

CHART 2.—Chart showing the distribution of positive reactors, etc., in Companies.

It will be noted from the figures recorded in Chart 2 that a much higher positive reactor-rate existed in two of the companies than is usually found in groups of young adults, and that the greatest number of cases occurred in these companies. The numbers, of course, are too small and even double swabbing of the throat too inaccurate a method for the

detection of all carriers, but the figures do suggest a relationship between the percentage of positive reactors and the carrier-rate in producing clinical diphtheria.

Immunization.

In view of the fact that all the non-immunes were adults it was decided to use Toxoid-Antitoxin-Floccules (T.A.F.) as the prophylactic. It was found, however, that insufficient stocks were available for immediate use and, consequently, Toxoid-Antitoxin-Mixture (T.A.M.) was substituted in a certain number of cases for the initial dose. Fresh stocks of T.A.F. arrived in time for the subsequent injections so that every positive reactor received at least two doses of this preparation.

Out of 122 individuals who received T.A.M. (0·5 c.c.) as the initial dose of prophylactic fifteen complained of both local and general reactions, one of which was severe. This particular case had shown a violently positive Schick reaction in twenty-four hours, which is in accordance with the findings of most workers. Four others, however, showed similar skin reactions but did not appear to be affected by the immunizing agent. Reactions were not noted after the primary or subsequent doses of T.A.F.

Development of Immunity.

As will be seen from Chart I, the last dose of T.A.F. was administered on February 20, 1936. On April 11, 1936, seven weeks later, the original non-immunes who had received the immunizing agent were again Schick-tested and of these individuals only 3 per cent still gave positive reactions. The test was carried out with the same batch of Schick toxin that had been originally supplied and which had been stored in the electric refrigerator ever since.

Diphtheria in Schick-negative Reactors.

On March 25, 1936, Pte. D. was admitted to hospital with a mild pyrexia, general malaise and a sore throat. The patient did not appear to be ill and the condition was thought to be one of follicular tonsillitis. Three series of throat swabs, taken at intervals of forty-eight hours, yielded cultures of an hæmolytic streptococcus, but diphtheria bacilli were not seen. On the seventh day further swabbing resulted in the culture of small numbers of *C. diphtheriæ* which subsequently proved to be virulent. Clinically the case was not suggestive of diphtheria and as the individual had been a Schick-negative reactor a few weeks previously he was regarded as a carrier. Nevertheless he was given 12,000 units of diphtheria antitoxin and nursed with caution. It has just been reported that the patient developed paresis of the ocular muscles and later palatal paralysis.

Originally the case was not thought to be a diphtheritic infection and was not, in consequence, included in the account of the outbreak. In

view, however, of the nervous complications it must now be considered as a true case, although the characters of the organism isolated suggest that it was not the same variety as the epidemic strain.

Discussion.

The exact origin of the outbreak described above remains obscure. It is known that faucial diphtheria occurred in the vicinity before any cases were notified in the particular battalion concerned, and it is also appreciated that there is a considerable amount of unrecognized diphtheria, both faucial and cutaneous, in this North-West Frontier area of India amongst the civil population.

Three factors existed for the ideal spread of the disease, viz. abraded skin surfaces, a high carrier-rate and the presence of an abnormally large number of non-immune adults who were in constant contact with each other. Although the spread of the infection, to a certain extent, must have occurred during the normal daily contact, it appears likely that the infection of many of the wounds with *C. diphtheriæ* took place in the medical inspection room where large numbers of the men attended daily to receive dressings for their abrasions. The whole staff was very carefully examined but it was not possible to obtain any direct positive evidence beyond the following: The small son of one of the N.C.O.s grazed his knee whilst playing in the compound and was sent to the medical inspection room to have it dressed. The graze did not heal and eight days later diphtheria bacilli were cultivated from the ulcer that was beginning to develop. The only contact that the child had with any diphtheritic cases was with the men who were having their wounds dressed and who were subsequently found to be harbouring *C. diphtheriæ*.

It is not possible, of course, to know the Schick reaction of the majority of the patients before they contracted skin lesions, but after the skin reactions had been recorded the cutaneous infections were only observed in the non-immunes. From the progressive nature of the early series of ulcers and their immediate response to specific treatment it is fairly certain that these too could not be regarded as carriers.

The infection of a wound with *C. diphtheriæ* can produce a disease in which the essential pathological processes are the same as in the classical faucial type. The absorption of the toxin in the cutaneous cases may not be so great, but that is probably due to the nature of the tissue supporting the lesion. Nevertheless the fact that the nervous complications of the cases under review were nearly as frequent after a cutaneous infection as after a faucial is proof that the toxin is absorbed.

Whilst certain cases of "Frontier Sore" may originate as a direct infection with diphtheria bacilli, it would appear unlikely that this is frequently the case. The writer has examined very large numbers of septic skin conditions (known variously as desert sore, frontier sore, etc.), both in Egypt and in India, without finding diphtheria bacilli. It is not

sound, therefore, to assume that *C. diphtheriæ* is of great importance as a primary ætiological agent in the causation of frontier sore, although as a secondary invader it must be treated with all seriousness.

Either type of diphtheria can give rise to the other and the recent utterance of Rolleston, quoted above, with regard to the danger of the non-recognition of the cutaneous lesion is very pertinent to the occasion. The skin infection is simply an extrafaucial manifestation of the disease and even fuller precautions should be taken with this type to prevent the spread of the infection than in faucial cases.

It cannot be maintained that the outbreak was cut short entirely by the immunization of the non-immunes. In spite of the intensive search for carriers it was obvious that some were being missed, for cases continued to occur, even though at longer intervals, and it was not until the positive reactors began to develop immunity that the infection appeared to be stamped out.

The fact that within seven weeks of the administration of the last dose of prophylactic only 3 per cent of the original non-immunes remained positive reactors is additional evidence of the value of T.A.F. as a most suitable agent for the rapid production of immunity in adults with the minimum of inconvenience from reactions.

Summary.

(1) A limited outbreak of diphtheria is described, in which the cutaneous form, a superadded infection in existing wounds, was twice as frequent as the faucial type.

(2) An account is given of the skin lesions.

(3) Seventy-three strains of diphtheria-like bacilli were isolated during the outbreak and investigated bacteriologically. Sixty-one strains proved to be virulent *C. diphtheriæ mitis*; they consisted of 31 cultures from skin lesions, 15 from faucial lesions, and 15 from healthy throats.

(4) The Schick reactions of the affected battalion are recorded, both before and after the administration of an immunizing agent. There were originally 27 per cent Schick-positive reactors, and within seven weeks from the last injection of the prophylactic (T.A.F.) only 3 per cent of the original non-immunes still reacted to the toxin.

(5) A case of diphtheria in a Schick-negative reactor is reported.

Acknowledgments.

I have to thank the A.D.M.S., Rawalpindi District, Colonel A. A. McNeight, V.H.S., I.M.S., for his interest in the work and permission to send this account for publication, and the various medical officers who carried out the medical inspections of the troops, collected the specimens and treated the cases and finally the Wellcome Foundation, without whose courtesy and organization the complete investigation would not have been possible.

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"DOWNWARD DISPLACEMENT" DISINFECTION.

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PART I.

(*Continued from p.* 232.)

Some Theoretical Considerations.

(1) Before drawing any conclusions from Table III, it is advisable to recall the conditions under which the experiments were carried out and also review some of the actions of steam in a downward displacement disinfector.

(2) The penetration times which were observed in Boxes A, B and C were obtained in somewhat roughly made apparatus. The three boxes were constructed as far as possible with similar materials and on the same lines, but it is quite possible that they may have varied slightly in their heat insulating properties.

The heat losses from the boxes were not calculated, but slight loss from all the boxes, as felt by the hand, was found to occur, although no gross differences between the boxes were so observed. Boxes B and C were newly constructed for the experiments, whilst Box A was constructed twelve months previously and had been considerably exposed to weather conditions.

(3) It has also to be admitted that the numbers of observations made with each box, packed at the various degrees of tightness, are small. Six observations were made with each box when blankets occupied 0·45 cubic foot each, and three observations were made in each box when blankets occupied 0·38 and 0·59 cubic foot respectively. Single observations have been discarded, i.e. when blankets occupied 0·36 and 0·53 cubic foot.

The probable errors of the "constants" shown in the column "averages of 'XY's'" vary from 62 to 293, and the approximation of these averages to the truth varies accordingly.

(4) In recalling the action of steam, it is to be noted that, in the first place, the incoming steam displaces the air lying between the fibres of material and also between the folds of blanket and that, secondly, the steam heats a definite mass of material by imparting latent heat to the surface of the blanket and fibres.

(*a*) If a blanket is packed tightly, its mass does not alter, but the amount of air between the folds, and possibly between the fibres of material, is lessened. It might be expected therefore that, in acting on a tightly packed

blanket, steam would penetrate the blanket more quickly, since it has the same mass to heat but less air to displace.

Displacement of air, however, is a quick process; for example, the 30 cubic feet of air in Box A, when containing no blankets, is displaced in one minute by the steam produced from a boiler evaporating about 75 pounds of water per hour (1 pound water = 26 cubic feet steam).

It would appear, therefore, that the air content of a box, "filled" with blankets, however packed, must be displaced very rapidly and that the penetration time per blanket is little affected in this manner by the amount of air in and around the blanket.

(*b*) The tightness at which a blanket is packed may influence the penetration time in another way.

We may suppose a blanket to be so tightly packed as to exclude all air from between the folds and between the fibres, in which case the blanket becomes a solid mass comparable to a lump of lead. In such case, steam, impinging on the surface and giving up its latent heat, will first heat the surface layers of the solid mass, and subsequent heating of the mass will be by conduction from fibre to fibre. This is a slow process compared with extensive surface heating, which results when the blanket is less loosely packed, i.e. with air in contact with all its surfaces. In none of the experiments were blankets packed tightly enough to exclude air, as was shown on all occasions by the shrinkage in the volume of the blankets seen on opening the boxes after steam had penetrated, such shrinkage in volume being caused by the falling together of the material after the displacement of air.

(*c*) In comparing boxes of equal cubic capacity, packed at differing degrees of tightness, the penetration time of the more tightly packed box would be expected to be longer than for a loosely packed box, since the total mass of blanket to be raised to steam temperature is greater in the tightly packed box.

(5) (*a*) A further action of the steam to be considered is the heating of the inner surfaces of the box.

The same amount of heat is required to heat the whole internal surface of the box, whether the box is filled with a few loosely packed, or many tightly packed blankets. This heat is obtained from the steam, which is thus diverted from its intended function of heating (or penetrating) the blankets. Diversion of the steam in this manner delays penetration of the blankets. The total delay from this cause is the same whether the box is loosely or tightly packed, but the delay in penetration time per blanket will be greater in the loosely packed box than in the tightly packed box, i.e. the penetration time per blanket will be increased as the cubic space occupied by a blanket increases, other conditions being equal.

The increase of penetration time per blanket due to the above cause is proportional to the amount of internal surface of the box per blanket.

(*b*) It also follows that, in dealing with two boxes of equal volumes, i.e.

equal blanket holding capacity, but of differing shapes, so that their internal surface areas are unequal, the penetration times per blanket will be longer in the boxes with the greater internal surface area.

(*c*) During and following the heating of the inner surface of the box, some of the heat is conducted through the walls of the box. With the external surface of the box at atmospheric temperature, there is a constant flow of heat through the wall of the box to the external surface, so long as steam enters the box. In an imperfectly insulated box the heat loss can be recognized by the hand and the external surface of the box can be felt to become warm from above downwards, the warmth keeping pace with the downward descent of the steam through the box.

Loss of heat, in this manner, diverts steam from its intended function of heating the blankets, etc., inside the box, and the greater the heat loss the greater will be the diversion of steam, until, with a sufficiently low rate of steam entry and a sufficiently high rate of steam loss, there will be insufficient steam to penetrate the box contents. It also follows that a given rate of heat loss through the walls will have more effect in delaying penetration of the blankets at low rates of steam entry than a similar loss will have at high rates of steam entry.

(*d*) The amount of heat lost through the walls of a box, due to inequalities of temperature on its inner and outer surfaces, is directly proportional to the surface area involved, per unit of time. It follows then that boxes of equal cubic capacity (i.e. equal blanket-holding capacity), but with different shapes and therefore of different internal surface areas, will have unequal heat losses per unit of time, assuming their insulating properties are equal.

Since heat losses affect the penetration times (as noted above (5) (*c*)), then the penetration times per blanket would be expected to vary in such differently shaped boxes, and such variation would be most marked at low rates of water evaporation.

(6) We may next consider whether heat loss through the walls of a box affects the penetration times of blankets packed at different degrees of tightness, and may confine our considerations to one box, so that shape and size factors have no influence.

The penetration time for a whole box, tightly packed, is expected to be longer than for a loosely packed box, as previously noted in (4) (*c*) above.

The heat loss per minute through the walls of the whole box is the same whether the box is tightly or loosely packed, because heat loss depends on surface area, time, conductivity of walls and temperature differences between inner and outer surfaces, and none of these factors for the whole box is affected by the tightness of packing.

The more loosely a box is packed, however, the greater is the amount of internal surface area of box per blanket, and therefore the greater the amount of heat loss from the box per blanket. It follows that the penetration time of a blanket in the more loosely packed box is expected to be greater than that of a blanket in the tightly packed box. This increase in

penetration time is expected to be more marked with low rates of steam entry than with high rates. The penetration times per blanket will also vary as the internal surface area of box per blanket.

(7) Finally, we may consider whether heat loss through the walls of a box is affected by differences due to variation in size of the boxes, and for this purpose, we may consider the heat losses in the two boxes A and C, which have similar shapes but differ in their cubic capacity. Box A, which holds three times as many blankets as Box C, has an internal surface area of 8,414 square inches, whilst the internal surface area of Box C is 4,140 square inches, approximately half that of A.

Since heat loss through the walls is proportional to the surface area involved, other factors being equal, it follows that Box A will lose about twice as much heat as Box C, but whilst doing so, three times as many blankets are penetrated. There is, therefore, an increased rate of heat loss during the penetration of one blanket in Box C as compared with Box A. It follows, therefore, that (from (5) (*c*) above) the penetration time per blanket in Box C will be increased as compared with Box A, and that this increase will be most marked at low rates of steam entry, and least marked at high rates of steam entry, and will also vary with the internal surface area of box per blanket.

(8) It will be useful to summarize the results to be expected from the theoretical considerations just discussed.

Differences in the penetration times per blanket in Boxes A, B and C may appear because of the following factors :—

(*a*) Small number of observations and statistical errors ; (*b*) roughness of apparatus and errors of observation ; (*c*) unequal amounts of *heat absorption* (in heating the inner lining of the box) due to unequal internal surface area of box per blanket and caused by : (i) Variations in tightness of packing, (ii) differences in shape of boxes, (iii) differences in size of boxes ; (*d*) unequal heat *losses* (through the walls of a box) due to unequal surface area of box per blanket and caused by : (i) variations in tightness of packing, (ii) differences in shape of boxes, (iii) differences in size of boxes. The differences in penetration times due to heat losses are expected to be most marked at low rates of steam entry and vice versa, and also to be proportional to the internal surface area of a box per blanket.

Conclusions from Table III.

(1) The penetration time per blanket varies inversely as the amount of water evaporated, i.e. doubling the amount of water evaporated halves the penetration time.

Whilst the above statement is true as regards the relative decrease obtained by doubling any given rate of evaporation, it will be seen that in practice the absolute decrease in penetration time is very small at the higher rates of evaporation.

Similarly, the absolute increase in penetration time becomes very great at the lower rates of evaporation.

It would appear, therefore, that what might be termed the "useful working range" of boiler evaporation, lies between 30 and 100 pounds per hour.

(2) There are no significant differences in the constants and therefore in the penetration times in the following extract from Table II:—

Box	Volume per blanket in cubic feet	Value of "XY" (Constant)	Internal surface area of box per blanket in square inches
C	0·38	2,088	153
A	0·45	2,095	122
A	0·59	2,176	165
A	0·38	2,178	104
B	0·45	2,198	186

The broad conclusion is that the differences of size and shape of the boxes, and variations in tightness of packing have very little effect.

(3) Box C, packed at 0·45 cubic foot per blanket, *vide* column 2, Table III, appears to give a better result than Box A, however tightly packed, although at a disadvantage (theoretically) as regards size.

It should be noted, however, that the experiments made with blankets at 0·45 and 0·38 cubic foot, were carried out with higher rates of steam entry in Box C than Box A, thus minimizing the disadvantages of C.

Also it will be remembered that Box C is a much newer box than A and may therefore retain heat slightly better, though no evidence is available on this point.

(4) Box B gives worse results than Box A; this is to be expected as Box B is at a disadvantage in respect of size and shape. There is no compensation of heat loss by increased steam entry as the observations in Boxes A and B were made with approximately the same rates of steam entry.

Box B is a newer box than A and may therefore retain heat slightly better, though no evidence is available on this point.

(5) The longest penetration times are shown in Box C at volume 0·60 cubic foot per blanket and Box B at volume 0·59 cubic foot per blanket. This is to be expected from the greatly increased internal surface area of box per blanket. The increased area is due to differences in size and shape as compared with Box A. There were no compensating high rates of steam flow in the experiments in these boxes at the volumes indicated.

(6) Table III shows fairly clearly that a large increase of surface area of box per blanket affects the penetration time per blanket but differences due to small increases are not so obvious. This may be due to statistical or experimental errors or possibly because small differences produce insignificant effects.

(7) The increased heat loss per blanket from the increased surface area per blanket due to loose packing is well shown by the lengthened penetration times at volumes 0·59 and 0·60 cubic foot in Boxes B and C respectively.

An increase in volume from 0·38 to 0·45 cubic foot is accompanied, contrary to expectation, by a decrease in penetration time in all three boxes. The differences are small and possibly insignificant.

It will be noted that an increase in volume from 0·38 to 0·45 (i.e. 0·07 cubic foot per blanket) results in an increase of approximately one-sixth in the surface area of box per blanket, whereas an increase from 0·45 to 0·59 cubic foot, i.e. 0·14 cubic foot per blanket, results in an increase of approximately one-third in surface area of box per blanket (*vide* figures at the foot of all columns Table III). It is to be expected that this large difference would stand out clearly and this is found to be the case in Boxes B and C.

From this it would appear that it is a disadvantage to pack at 0·59 cubic foot per blanket.

In connexion with this question of tightness of packing, Colonel Hammond-Searle informs me that in packing containers of various shapes and sizes he has found that when the blankets are packed unfolded in a "normal manner," i.e. without previous decision as to whether they will be tightly or loosely packed, the blankets have been constantly found to occupy a volume of 0·45 cubic foot each.

In the present series of experiments, when it was desired to pack the blankets at 0·38 cubic foot, they had to be forcibly compressed in order to get them into the box, by stamping on them—a definitely abnormal way of packing. Again, when the blankets were packed so as to occupy 0·59 cubic foot, great care had to be taken to pack loosely enough for the boxes to be filled without leaving a large empty space in the box; this again is an abnormal method of packing.

(8) Table III shows the influences of various factors on the penetration times per blanket, but the relative influence of these factors remains to be decided.

The amount of water evaporated by the boiler per hour is one factor and its influence has already been noted.

The other factors influencing the penetration time (i.e. shape and size of boxes, tightness of packing) do so because they affect the internal surface area of box per blanket.

The question therefore becomes—what is the relative influence of water evaporation and internal surface area of box per blanket respectively on the penetration time? It has already been seen that the differences in penetration time with varying amounts of internal surface area of box per blanket are in several instances insignificant, or overlaid by errors, so that the influence of small variations in internal surface area of box per blanket is not apparent.

The influence of the largest difference in internal surface area is seen when the penetration times in Box B, with volume per blanket of 0·59 cubic foot, is contrasted with Box A, volume per blanket 0·38 cubic foot, where an increase of $252 - 104 = 148$ square inches of internal surface area of box per blanket, i.e. an increase of 144 per cent, lengthens the penetration time by 18 per cent only, whereas an increase of 144 per cent in the rate of water evaporation decreases the penetration time by 60 per cent.

We may conclude, therefore, that small differences in the internal surface area of box per blanket are insignificant, and that large differences influence the penetration time to only one-third of the extent to which similar differences in water evaporation influence it.

Summary.

(1) Experiments were undertaken to determine the factors influencing the output of a "downward displacement" disinfector.

(2) It was found that the output of the disinfector varies directly with the boiler output, and that, e.g., doubling the latter doubles the disinfector output.

(3) The boiler should have an output of between 30 and 100 pounds of steam per hour at atmospheric pressure. Where time is of no importance the lower limit of boiler output may be employed, but where it is desired to attain the maximum disinfector output in a given time, the boiler should have an output of 100 pounds per hour.

(4) Heat losses from the disinfecting chamber, due to faulty insulation or to the use of a chamber which is not of the optimum shape or size, are minimized to a greater extent by a boiler having an output of 100 pounds steam per hour than by a boiler having a lesser output. The disinfector output is correspondingly increased by the use of the greater boiler output.

(5) The output of the disinfector is very little affected by the size or shape of the disinfecting chamber, but where it is possible to employ the disinfector under ideal conditions the optimum sized chamber is the largest and the optimum shape is spherical or cubical. Employed in the field, however, the size and shape of the disinfecting chamber may be modified to suit requirements of transport, space, and weight, with very little loss in disinfector output.

(6) The disinfector output is little affected by the exact degree of tightness at which blankets are packed, assuming these are packed in a "normal manner."

(7) The output of the disinfector is affected by heat losses from any cause, and the amount of heat loss present will be affected by weather conditions. The present experiments were carried out between February 25, 1936, and March 27, 1936; during this period the shade temperature varied between 40° and 53° F., and some of the days were calm and some were windy. The heat losses from the boxes would vary with variations in air temperature and air movement, being greater with low air temperature and a high rate of air movement and vice versa.

If the experiments had been carried out in mid-winter the heat losses would probably have been greater and the penetration times per blanket longer. If, on the other hand, the experiments had been carried out in mid-summer the penetration times would probably have been less. It is likely that in boxes insulated to the same degree as Boxes A, B, and C, the output of blankets may be decreased by 30 per cent in winter as compared with the output in summer. Heat losses from any cause should be guarded against in the construction of the apparatus.

PART II.

In the series of experiments recorded in Part I of this paper, the following constants were obtained in Boxes A, B, and C (*vide* Table III, Part I).

	Constant	Box	Volume per blanket in cubic feet	Surface area of box per blanket in sq. inches
(1)	1,896	C	0·45	180
(2)	2,088	C	0·38	153
(3)	2,095	A	0·45	122
(4)	2,176	A	0·59	165
(5)	2,178	A	0·38	164
(6)	2,198	B	0·45	186
(7)	2,333	B	0·38	159
(8)	2,343	C	0·60	244
(9)	2,576	B	0·59	252

It was expected, for the reasons stated in Part I, that the constants shown at (8) and (9) above would be greater than the others, because of the greatly increased surface area of box per blanket. These constants (2,343, 2,576) were obtained when the blankets were packed in an abnormal manner, i.e. very loosely, and in the case of Box B, in a box of unusual proportions. It is thought, therefore, that these constants (2,343, 2,576) should be omitted from subsequent calculations.

The mean of the remaining seven constants is 2,138 and the probable error of the mean is 65, so that in another series of similar observations the mean might lie between 2,073 and 2,203.

It is admitted that these figures are but rough approximations to the truth, but they may be useful : (*a*) As a guide in constructional work ; (*b*) as a check on further experimental work in *similarly constructed* or *the same boxes.*

Graph *D* shows the curve of the equation :—

$$xy=2{,}138.$$

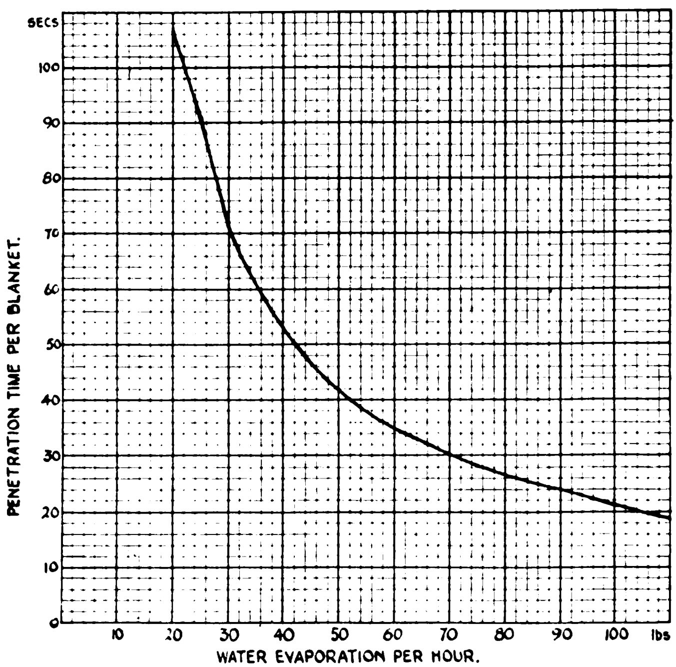
The graph may be used to read off the evaporation of water required to effect penetration of a blanket in a given time, e.g. : If a disinfector is required to have an output necessitating the penetration of a blanket in sixty seconds, then the evaporation of water (from graph) must be between 34 and 37 pounds per hour, or say 30 to 40 pounds per hour.

Conversely, if a boiler evaporates 100 pounds of water an hour, then the

penetration time per blanket will be about 18 to 25 seconds, and from this the expected output of a disinfector can be calculated.

For the above statements to hold true the heat losses from the disinfecting chamber and steam pipe must be the same as those obtaining in the experiments carried out in Boxes A, B, and C.

GRAPH.D.



It should also be noted that in applying the data from Graph 'D' to the disinfection of men's kits, it is probable that the penetration time of Service dress material may vary slightly from that of an equal weight of blanket. The variation is probably slight, and possibly insignificant, compared with the other factors, and it will suffice here to note its probable occurrence.

Practical Application—A Unit Disinfector.

The considerations and conclusions arrived at so far, may be applied practically in considering the design of a Unit Disinfector.

Problem.—Unit Disinfector capable of dealing with a platoon (say 50 men) in one morning (say four hours).

Conditions.—(1) Disinfector to be as light, small and portable as possible; (2) disinfector to be adaptable to carriage on wagon or pack; (3) disinfecting chamber may be double, i.e. two concentric boxes (called "A" and "B" respectively) housing as much of the apparatus as possible.

Boiler.—(*a*) Evaporative capacity—the amount of water to be evaporated per hour depends on the penetration time per blanket aimed at. A boiler evaporating from 40 to 45 pounds of water per hour will be required (*see* Appendix 2); (*b*) type—enclosed fire-box type (*see* figs. 2 and 3) heated by

FIGURE 2.

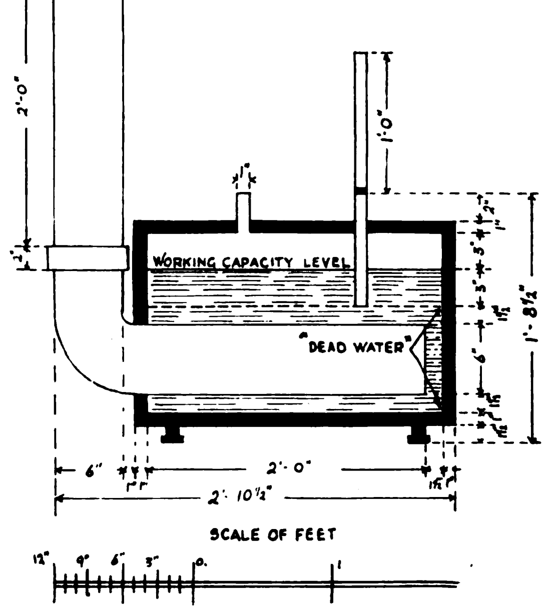
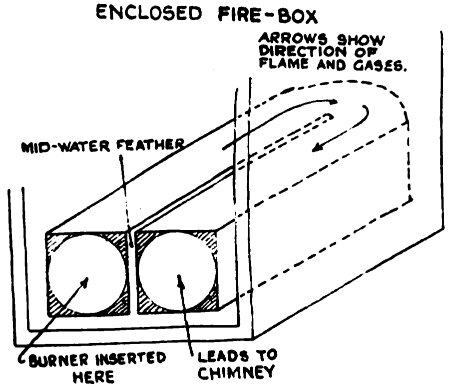


FIGURE 3.

ENCLOSED FIRE-BOX



a Rutherford burner; (*c*) size—must accommodate (i) "dead water," i.e. all water below the level of internal end of filling pipe and (ii) sufficient water to give, say, one hour's steam. The boiler will then require to be refilled hourly or at some lesser interval; (*d*) design—suggested boiler is shown in figs. 2 and 3, and further details in Appendix 3.

Burner.—Rutherford (½-gallon type) burner should be sufficient to

produce 40 to 50 pounds of steam per hour in this boiler. The large (one-gallon type) burner produces 100 to 110 pounds of steam in a similar type of boiler at present under trial for a large disinfector.

Disinfecting Chambers.—(i) Size: "A," larger chamber, is to contain "B," the smaller chamber, which is to contain the boiler.

"B," internal measurements 21 by 21 by 36 inches = 9·2 cubic feet = 5·1 kits or 20 blankets.

"A," internal measurements 25 by 25 by 39 inches = 14·1 cubic feet = 7·8 kits or 30 blankets.

"A" will contain "B" with such projections as exist on the present Mule Pack Disinfector (handles, hinges, catches, bands).

"B" will contain the boiler, dismantled chimney and filling pipe, and flexible pipe which conveys steam from boiler to chamber; (ii) design: the same construction as the mule pack disinfector boxes, with more attention to insulating material.

OUTPUT OF DISINFECTOR.—Estimated that when steam has once been raised the following output should be obtained in each hour:—

Disinfecting Chamber "A" 30 blankets	..	..	25 minutes
Allow steam to issue freely ..	..	..	5 ,,
Refill with 2 gallons water and boil	..	..	5 ,,
Disinfecting Chamber "B" 20 blankets	..	..	17 ,,
Allow steam to issue freely ..	..	..	5 ,,
Refill with 2 gallons water and boil	..	..	5 ,,
			62 minutes

Output would be 50 blankets an hour approximately.

Method of Carriage.—(*a*) On a wagon—Chamber "A" to contain Chamber "B" with boiler, chimney and filling pipe of boiler, and flexible piping for conveying steam from boiler to chambers.

Rutherford burner carried separately in a box. Oil supply carried separately in a drum. (*b*) On pack animal—Chamber A to contain burner and oil supply. Chamber B contents as above.

The above notes on a suggested unit disinfector are not intended to describe the apparatus fully, but to indicate the lines along which the problem may be solved.

GENERAL SUMMARY.

In Part I some of the factors affecting the output of a downward displacement disinfector are discussed, and a record of experiments analysed to determine the influence of these factors.

In Part II a curve is given which shows the boiler output required to effect penetration of a blanket in a given time in the boxes used for the experiments.

In addition, in Part II are notes on a suggested unit disinfector based on the data previously obtained.

ACKNOWLEDGMENTS.

It should be noted that the work recorded herein has been carried out as part of the writer's normal duties at the Army School of Hygiene, and

the writer wishes to acknowledge the great assistance he has received from the successive Commandants, Army School of Hygiene, Colonel H. A. Emerson, D.S.O., and Colonel A. C. Hammond-Searle, M.C., under whose direction and with whose helpful advice and criticism the work has been carried out. The writer wishes also to thank Serjeant Dugmore, R.A.M.C., for his able assistance during the experiments, and Corporal Blackburn, R.A.M.C., for constructing the boxes.

APPENDIX 1.

EXPERIMENT No 3. MARCH 19, 1936.

Before this experiment the Rutherford burner was dismantled and thoroughly cleaned. 30 gallons water. Temperature 50° F. 31 pints paraffin. Burner run at 20 pounds pressure.

9.40. Burner lit and applied to boiler.
10.35. Steam up (55 minutes) and turned into Box A (69 blankets).
11.17. First wisps of steam emerge.
11.30. Steam issues in full volume (55 minutes).
11.35. Steam turned into Box B (23 blankets).
11.46. First wisps of steam.
11.53. Steam in full volume (18 minutes).
11.56. Steam turned into Box A (51 blankets).
12.32. Steam issues in full volume (36 minutes).
12.34. Steam turned into Box B (17 blankets).
12.45. First wisps of steam.
12.49. Steam issues in full volume (15 minutes).
12.51. Steam turned into Box A (69 blankets).
12.55. 9 pints oil added to burner.
1.28. First wisps of steam.
1.45. Steam issues in full volume (54 minutes).
1.46. Steam turned into Box B (23 blankets).
2.04. Steam issues freely (18 minutes).
2.08. Burner dowsed.

Oil remaining, 6 pints; oil consumed, 34 pints; water remaining, 12 gallons; water evaporated, 18 gallons.

EXPERIMENT No 7. MARCH 27, 1936.

30 gallons water, temperature 48° F. 28 pints paraffin in burner; run at 25 pounds pressure.

9.23. Burner lit and applied to boiler.
10.08. Water boils (45 minutes).
10.09. Steam turned into Box C (23 blankets).
10.18. Steam issues in full volume (9 minutes).
10.19. Steam turned into Box A (81 blankets).
10.45. First wisps of steam issue.
10.54. Steam issues in full volume (35 minutes).
11.01. Steam turned into Box C (23 blankets).
11.10. Steam issues in full volume (9 minutes).
11.12. Steam turned into Box A (51 blankets).

11.31. Steam issues in full volume (19 minutes).
11.38. Steam turned into Box C (23 blankets).
11.47. Steam issues in full volume (9 minutes).
11.47. Steam turned into Box B (27 blankets).
12.00. Steam issues in full volume (13 minutes).
12.02. Steam turned into Box C (23 blankets).
12.10. 2 gallons oil added to burner.
12.11. Steam issues in full volume (9 minutes).
12.13. Steam disconnected from box.
12.14. 8 gallons water added to boiler; goes off boil.
12.27. Water boils (13 minutes).
12.31. Steam turned into Box A (84 blankets).
1.09. Steam issues in full volume (38 minutes).
1.12. Steam turned into Box C (27 blankets).
1.24. Steam issues in full volume (12 minutes).
1.25. Steam disconnected from box.
1.32. Steam turned into Box C (19 blankets).
1.42. Steam issues in full volume (10 minutes).
1.43. Burner dowsed.

Oil remaining, 4 pints; oil consumed, 40 pints; water remaining, 14 gallons; water evaporated, 24 gallons.

APPENDIX 2.

Problem.—To disinfect 50 men's kits in four hours, when steam has once been raised = 12½ men's kits in one hour, or 50 blankets in one hour.

But every hour time is lost in: (1) Refilling boiler and reheating water—say ten minutes; (2) allowing steam to "issue freely" from each box to ensure thorough disinfection—say ten minutes. Total time lost per hour = twenty minutes.

The problem is now to penetrate 50 blankets in forty minutes, i.e. one blanket in forty-eight (say fifty) seconds.

From Graph D a boiler evaporating 40 to 45 pounds water per hour will penetrate the blanket in fifty seconds in a well-insulated box.

The boiler must evaporate 40 to 45 pounds per hour, and this amount of water will require to be added hourly to the boiler.

APPENDIX 3.

Boiler.—(1) Firebox, 24 inches long, 13 inches wide, 6 inches deep, having a 1 inch mid-water feather. Cubic capacity of firebox, excluding mid-water feather = 1 cubic foot.

(2) "Dead water"—all water below level of internal end of filling pipe = 6·85 gallons.

(3) Boiler capacity up to 3 inches above dead water line = 11·25 gallons.

(4) Amount of water which can be evaporated before refilling becomes necessary —44 pounds. Refilling should be carried out after each disinfection, say 2 gallons at a time.

(5) Chimney and filling pipe are in sections to diminish height.

(6) Overall measurements for packing in chamber—34½ by 20½ by 18 inches wide.

THE TRAINING OF PERSONNEL IN FIELD AMBULANCE DUTIES.[1]

By Lieutenant-Colonel H. G. WINTER, M.C.
Royal Army Medical Corps.

THE object of military training is to prepare the Army for war.

Training Regulations lay down that: "The aim in training must be to produce efficient leaders, a well-trained staff, units well disciplined, hardy and skilled in the use of their weapons, and administrative services familiar with their war responsibilities."

This object is attained both by theoretical and practical means. Theoretically, by lectures, staff tours, training exercises without troops, etc., and practically by individual and collective training.

The majority of units in the British Army are organized in peace time as they would be in war and only require to be made up to full establishment in personnel and material to bring them up to a war footing. Practical training for war can thus be carried out continuously in peace time.

The Royal Army Medical Corps, however, is an exception. Peace organization is entirely different from that of war. Certain units, such as casualty clearing stations, field ambulances, motor ambulance convoys, etc., which are essential in war time, do not exist in times of peace.

Theoretical training can be, and is, carried out in peace time, but the difficulty is to provide all ranks with the necessary practical experience in the handling and administration of war time units.

The essential unit and the pivot of all clearing and evacuation of sick and wounded in war is the field ambulance. A thorough, first-hand, practical knowledge of field ambulance work is essential to the training of all ranks of the Corps and, given such knowledge, the handling of other war units becomes a simple matter.

In the past, periodically, training field ambulances have been formed both at home and abroad during the training season for instructional purposes. In the future, I understand, this is to become an annual event.

It has been my good fortune to be selected as adjutant of three of these training units and still further to have had as Commandant two officers whose knowledge of field ambulance work is unsurpassed—Lieutenant-Colonel W. Bennett at Shorncliffe in 1926 and Colonel A. D. Fraser at Tidworth in 1928 and again at Tidworth in 1935.

I propose to give a short account of the three training camps I have attended and then to summarize their advantages and defects. Opinions given are my own and must not be taken as official pronouncements.

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[1] Lecture delivered to the Officers, Warrant Officers, and Senior Non-Commissioned Officers, R.A.M.C., at the Royal Victoria Hospital, Netley, on January 7, 1936, as part of the winter training programme.

My first camp was situated at Dibgate Camp, Shornliffe, in 1926. For this we were given as permanent staff a Commandant, Adjutant, Quartermaster, Serjeant-Major and about five N.C.O.s and men, also medical and ordnance equipment and transport for one field ambulance.

Officers and men sent for training were sufficient, numerically, to staff two field ambulances—one Regular and one Territorial.

The camp was held in conjunction with brigade manœuvres as both the Shorncliffe and Dover Brigades were carrying out field training.

Training consisted of instructing all ranks in the formation and tactical handling of the unit and each senior officer in turn was given command for a day's field exercise.

Equipment and transport were divided up so as to provide, as far as possible, one field ambulance for each side. The fact that both Regular and Territorial Units were present produced a spirit of friendly rivalry that did much to increase the value of the training.

Holding such a camp in conjunction with the field training of other formations was of very great value from a practical point of view, more especially as the brigade staffs included medical situations in their schemes and were very helpful.

A great drawback was the fact that equipment for one field ambulance only was provided instead of two.

One point brought out by this camp was the lack of efficient means of intercommunication in a field ambulance. On the one occasion on which I was in command of the Regular unit in the field, I completely lost touch with Brigade Headquarters, although a distinguished officer of the Corps was acting as liaison officer with the brigade staff. As a result I found myself holding up the advance of the enemy with my unit whilst the rest of the Brigade was carrying out a very successful flanking movement.

Towards the end the weather got very bad, and on the last night we marched into camp, soaked to the skin, to find all the tents flat and the ground a sea of mud. The late Earl of Ypres' dictum, "The darker the night, the more inclement the weather, the better the exercise," was but little consolation.

The second camp was not a training camp in the true sense. In 1926 it was abundantly clear that the Cavalry Field Ambulance, devised after the War, was an unpractical unit and incapable of efficient tactical handling.

A small band of officers, headed by Colonel Langford-Lloyd, commenced work at Tidworth in an effort to devise a more practical unit.

Problems that arose were:—

(1) The existing Infantry Field Ambulance, although not perfect, could be safely left for the time being.

(2) The Cavalry Field Ambulance was not a good unit, and moreover, the Cavalry Regiments were being partially mechanized.

(3) A new formation—a mechanized force, formed chiefly by the Royal Tank Corps—had come into being and had no medical unit.

Medical units had, therefore, to be devised for (2) and (3), preferably one unit for both.

After two years work (in July, 1928) the full complement of officers and men, R.A.M.C., for a Cavalry Field Ambulance, was sent to Tidworth and the full equipment of a Cavalry Field Ambulance was given to them. What mechanized transport they required was supplied and they were told to evolve a new unit. Thus "The Experimental Mechanized Cavalry Field Ambulance" was born and has become, in its original form and practically unchanged, the Cavalry Field Ambulance of the present War Establishments.

We tried out this unit with infantry, cavalry and the mechanized force and the conclusions drawn were that, whilst it was not sufficient for infantry, it was almost ideal for cavalry. As regards the mechanized force we formed the opinion that no special unit was required and that little could be done for this formation: one section of the Cavalry Field Ambulance consisting of a lorry with personnel and equipment and one motor ambulance car was all that could be sent with the force.

Incidentally, so far as I am aware, this was the first time our Corps had been given the opportunity to evolve a new unit and to try it out in practice. The insight given into the working of mechanized units and the realization of the practical problems involved were of inestimable value to all personnel who attended the camp.

In the summer of 1935 a field ambulance training camp was formed at Tidworth. The permanent staff consisted of Commandant, Adjutant, Quartermaster, and twelve Other Ranks, including a Quartermaster Serjeant, Corporal, cook, two Serjeant Instructors, Orderly Room Serjeant, and Bugler. Camp equipment, in addition to the full equipment of a field ambulance, both medical and ordnance, was supplied. Items essential for actual training were provided, non-essential items being represented by packages of the correct size and weight—these parcels were described as "mock ups"—thus adding a new term to our vocabulary. We even had a "mock up" padre and dental officer!

Full transport as per War Establishment was supplied. I believe that such places as the Imperial War Museum, etc., had to be raided to provide the horsed ambulance waggons. Gunner horses and personnel—including two officers—were sent from the artillery batteries at Bulford.

The camp was divided into two periods of nine days each. In each period 19 officers and 160 Other Ranks, R.A.M.C., attended. In each batch the senior officer was put in command of the unit and given his full complement of nine officers and 160 Other Ranks. The remaining officers were looked on as attached for training.

The commanding officer was instructed to take over his equipment and transport, detail his personnel to companies, and organize his unit as he would on mobilization.

A training time-table was worked out, beginning with the taking over, checking and loading of the equipment, proceeding through the forming of

advanced and main dressing stations up to the finale of two field days, after which there was the final closing down of the unit and the handing in of the equipment to store.

During the period, lectures and demonstrations were given, and problems were set. Personnel under training were left to carry out their duties in their own way, and their methods were criticized by the permanent staff and discussed at numerous conferences.

As a result of this method of training, all ranks were given a thorough grounding in the organization and equipment of the unit. No other formations took part in the exercises, and this was a serious drawback. Units at Bulford supplied personnel to be put out as casualties.

I have given above three examples of field ambulance training, each differing from the other in certain respects; I will now compare these and discuss the advantages and disadvantages of each.

The first camp at Shorncliffe had the big advantage of working with other units and formations; it was, moreover, held over a longer period and two field ambulances were trained at the same time. Better results would, in my opinion, have been obtained if the full equipment and transport for two units could have been provided, and if the units had worked longer by themselves and got used to the administration of their units before the big field days had been tackled.

The second camp amply fulfilled its purpose as is evidenced by the efficiency of the present Cavalry Field Ambulance. It was not, however, as previously stated, a training camp in the true sense.

The third camp was successful in that the largest possible number of officers and other ranks was given an insight into the equipment, organization and administration of a field ambulance in the shortest possible time. New items of medical equipment—such as the regimental medical pannier and the proposed field ambulance panniers, intended to replace field fracture boxes, &c.—were demonstrated and, in a special report on the camp at its conclusion, recommendations were made for the alteration of the medical and ordnance equipment in the light of experience gained at the camp.

There was not, however, sufficient time to give more than a very rough idea of its tactical handling. The fact that no other units or formations participated was also a serious drawback. Apart from Field Medical Cards and envelopes, no War Forms were provided. It would, perhaps, have been better if the stationery boxes had been filled. There are, for instance, few N.C.O.s in the Corps to-day who have any knowledge of Acquittance Rolls.

It would appear that what is now required is another camp to devise a suitable unit to serve the modern Infantry Brigade; such a unit to have light trucks, such as Morris trucks, and light ambulance cars to replace the limbered general service and horsed ambulance waggons. Ample means of intercommunication, such as plenty of dispatch riders and possibly

wireless, would also be required. I am, moreover, of opinion that the time has now come for us to have our own R.A.M.C. drivers in place of R.A.S.C. This would not only bring us into line with other units, but would also lead to a saving in peace time and would, moreover, do much to increase our preparedness for war.

As stated in the commencement of this lecture, methods of training are theoretical and practical; the greater part of the training for war of the R.A.M.C. is theoretical, and this is very good up to a point, but one cannot blame an officer at a staff tour for moving a Main Dressing Station an incredible number of miles in an amazingly short time on paper, when he has never seen such a formation in practice. The special object of a training camp is to give all ranks a first-hand working knowledge of a war unit and to bring to them the realization of the difficulties they would be up against. Given this practical knowledge the value of staff tours and similar theoretical training is considerably enhanced.

Responsibility for training methods rests with the higher command, but may I, in the light of past experience, be permitted to express my opinion on some of the points which require consideration in the formation of an ideal Field Ambulance Training Camp? Such opinions are intended in no way as a criticism.

(1) Training should, as far as possible, be carried out continuously throughout the year in preparation for the annual camp—this specially refers to staff tours, training exercises without troops, etc., for officers; map reading, instruction in special army forms, etc., for senior N.C.O.s; and squad, stretcher and Thomas' splint drill for the rank and file.

(2) The training camps should be held annually and should be of longer duration than in the past. This could be done with little or no extra cost, as money allotted us in training grants is usually amply sufficient.

(3) Camp equipment, including transport for rations, etc., should be provided in addition to the equipment of the unit and permanent camp staff should be sufficient for routine duties. This would leave the unit under instruction complete in men and material and able to concentrate on training.

(4) The camp should always be held as part of collective training as our duties in war are inseparable from those of other units in the force. About three-quarters of the time should be given up to individual and unit training and the remaining quarter to the carrying out of schemes with other units and formations.

(5) Far too much has to be left to the imagination in any case and skeleton and cadre units should not be attached during Brigade and Divisional manœuvres, as has been tried recently, as they fail to give any idea as what the full unit looks like and give both the personnel of the unit and other formations in the force a totally wrong impression. For the same reason, full equipment and transport should be issued and "mock ups" be reduced to a minimum.

Editorial.

RESEARCH WORK AT THE LISTER INSTITUTE OF PREVENTIVE MEDICINE DURING THE YEAR 1936.

DURING the past five years considerable attention has been paid by workers on virus problems to the elementary bodies which are now generally believed to be the sole effective ætiological agents in all virus diseases. The fact that these bodies can now be separated from crude virus material in a comparative state of purity has facilitated the study of their ætiological relationships.

The antigenic structure of the virus of vaccinia has been under investigation by Dr. M. H. Salaman since October, 1935. He has shown that by the use of an optimum flocculation technique, the flocculating power and the antiviral or neutralizing power of a potent anti-vaccinial serum can be removed by absorption with a V filtrate of rabbit dermal vaccinia.

Professor Ledingham and Dr. Gye have made experiments which seem to show that the filtrable tumour-exciting agents of the Rous and Fujinami fowl sarcomata are probably particulate in Nature. Dr. Amies has continued these investigations, and by means of a high-speed centrifuge acting for one hour, has completely removed the infective agent from potent cell-free tumour extracts. The re-suspended deposit thus obtained has been found in some cases to be more potent than the original tumour extract. By repeated fractional centrifugation it has been possible to obtain highly infective suspensions, which, according to serological tests, are free from fowl protein.

These elementary bodies are agglutinated in specific fashion by the serum of fowls bearing actively growing or regressing tumours.

Pericardial and pleural exudates and joint fluids from acute rheumatic fever and joint fluids and synovial membrane from acute rheumatoid arthritis have yielded suspensions of bodies which in stained preparations and by dark-ground illumination are indistinguishable from the elementary bodies found in similar suspensions in recognized virus diseases. Serological studies are being carried out, also agglutination tests with these suspensions using sera from different stages of rheumatic infection, sera from normal persons, and sera from cases of infection not attributable to virus diseases. It is hoped in this way to confirm the findings in acute rheumatic fever, to establish a possible virus ætiology in rheumatoid arthritis and to establish a relationship between acute rheumatic fever and acute and subacute rheumatoid arthritis by cross-agglutination tests.

In the department devoted to serological studies Dr. A. Felix has continued his investigations on the properties of the "Vi" antigen of *S. typhi* and the corresponding antibody. He finds this antigen is even more labile than the "H" antigen. Its agglutinogenic activity is destroyed by exposure to temperatures lower than that required for the inactivation of "H" antigen. Suspensions of "Vi"-containing bacilli killed by exposure to 0·5 per cent phenol are still agglutinable by the "Vi" antibody, but do not induce formation of the "Vi" antibody when used for the immunization of rabbits. Treatment with dilute hydrochloric acid inactivates both the "Vi" and "H" antigens, but does not affect the "O" antigen.

Alcohol inactivates the "H" antigen, but "Vi" retains its immunogenic activity unimpaired. These facts are considered to indicate that the chemical structure of "Vi" antigen of *S. typhi* differs profoundly from those of the "O" and "H" antigens.

The surprising fact has been discovered that the response to immunization with formolized "Vi" antigen is not identical with that resulting from immunization with the natural "Vi" antigen contained in the living bacilli. The phagocytosis-producing activity and the protective power of the former are much inferior to those of the latter, though there is no difference in the agglutinating properties of the two varieties of antibody.

When the "Vi"-containing strains of *S. typhi* vary from the smooth to the rough variant, the "Vi" antigen is not necessarily lost simultaneously with the smooth "O" antigen. Such variants, which are non-virulent, are yet capable of inducing active and passive immunity.

The virulence of *S. typhi* is considered to depend on the combined activity of the smooth "O" and the "Vi" antigen; nevertheless the "Vi" antibody alone is thought to be sufficient to protect against infection with strains of the highly virulent type.

The preparation of antityphoid serum by the original method of immunizing horses with suspensions of living virulent bacilli was not free from risk. This method could not be replaced by one using suspensions of bacilli killed by heating or by treatment with phenol or formalin since these procedures destroyed or greatly reduced the immunogenic value of the "Vi" antigen. For some time a rough, avirulent, but "Vi"-containing, variant served as the source of "Vi" antigen and the "O" antibody was produced by injecting a dead vaccine containing the smooth "O" antigen. Recently the method has been simplified by the use of alcohol treated suspensions containing both the "Vi" and the "O" antigens, as the "Vi" antibody produced by alcohol-treated suspensions was found to be as potent as that resulting from immunization with the natural "Vi" antigen contained in the living virulent bacilli.

With the recognition of the "Vi" antigen in antityphoid immunity, studies of the methods of vaccine preparation which will leave the antigen intact and as effective as possible are considered desirable. Dr. H. Schütze has shown by experiments with mice that for prophylactic purposes the

old method of heat-killing and phenol preservation is as efficient as any of the alternatives he has tested.

In the Division on Nutrition further work has been carried out on vitamin standards. A monograph, edited by Miss Hume and Dr. Chick, containing the existing information on the properties of pure β-carotene and the evidence regarding the spectrographic method of vitamin A estimation, has been published by the Medical Research Council. Further research is required on the conversion factor by which the results of the spectro-photometric test are to be multiplied in order to express the results in terms of international vitamin-A units. Comparisons are being made of the results of spectro-photometric examination of certain selected materials with those derived from biological tests carried out in several different laboratories.

The anomalous behaviour of irradiated ergosterol and cod-liver oil when given as anti-rachitic agents to poultry has made the standardization of vitamin D difficult. The standard is irradiated ergosterol and the usual biological tests are carried out on rats. The explanation suggested by the experiments of Windaus and others is that more than one form of vitamin D exists, that in cod-liver oil being different from that in irradiated ergosterol, and birds being relatively insensitive to this second form.

Further work on the two constituents flavin and B_6 of the vitamin B_2 complex by Miss Copping has confirmed the conclusion of György that vitamin B_6 prevents symmetrical florid dermatitis ("rat pellagra"), while flavin prevents the loss of hair without swelling from the skin of rats, and the serous exudation from the eyes and nostrils. The discovery of the composite nature of vitamin B_2 has rendered necessary a revision of Aykroyd's work on the presence of B_2 in cereals. Aykroyd showed that while whole wheat and whole maize contained small amounts of B_2, their respective endosperms contained even less. Miss Copping has investigated wheat, maize, and their milling products, and has found them to be good sources of vitamin B_6, but to be poor in flavin. Whole wheat contained more flavin than whole maize. Much of the vitamin B_6 in wheat and maize and of the flavin in wheat was contained in the germ and integuments of the whole grain, and the endosperm contained relatively much less.

These results which confirm the observations of György at Cambridge indicate that lack of B_6 cannot be connected with the ætiology of pellagra, since the maize diets on which the populations suffering from pellagra subsist are rich in this vitamin. Goldberger and his colleagues found that the foodstuffs which prevented pellagra were rich in flavin. But recent trials in the United States have shown that pure flavin has no curative effect on pellagrins.

Professor Ellinger has examined the urine of pellagra cases for porphyrin content and as controls the urine of normal people and patients suffering from other nervous diseases. The pellagra cases included endemic,

alcoholic and "secondary" pellagra: they all showed strong excretion of porphyrin, while the urine of the controls contained no porphyrin, or only traces, except after treatment with iron compounds. In the pellagra cases the excretion diminished simultaneously with the improvement under treatment. It is thought that the excretion of porphyrin is characteristic of pellagra and may provide a clue to the metabolic disorders causing the disease.

In the department for the study and preparation of therapeutic sera work on the therapeutic action of anti-meningococcus serum has been carried out by Dr. Petrie. The pathogenic action of the meningococcus is supposed to be due to the intracellular poison which is liberated in the course of the disease. But Dr. Petrie has found that this toxic substance is not antigenic and therefore the therapeutic efficacy of the serum cannot be ascribed to an anti-endotoxin and is probably dependent on an anti-bacterial mechanism.

Most investigators have found that very large doses of cocci when given intraperitoneally are required to produce a fatal infection in mice, and it is difficult to dissociate the pathogenic effects due to the endotoxin and to the coccal invasion. It appears now that some freshly isolated strains are highly virulent and the virulence of other strains is enhanced by incorporating mucin prepared from the gastric mucous membrane of the pig in the dose of the coccal suspension which is injected: the lethal dose may contain as few as ten to twenty cocci. By this means it has been possible to arrange protective experiments which show that immune sera from the horse can neutralize the pathogenic effect of many multiples of the lethal dose of living cocci. The mode of action of the mucin is not known but it is thought that the cocci are protected from the phagocytic cells of the host.

Dr. McClean has completed his investigation of the factor in culture filtrates of the gas-gangrene group and of certain other pathogenic bacteria which causes a marked and immediate increase of the permeability of the tissues. Experiments have shown that the diffusing factor in bacterial filtrates is distinct from any specific toxin that may be present in these and that it may be separated by a simple process of purification. Nevertheless the diffusing factor is manufactured mainly by toxigenic organisms, and the most toxigenic produce the most potent diffusing filtrates.

Purified solutions of the diffusing factor derived from *Cl. welchii* have been proved to be anti-genic and anti-diffusing sera have been prepared by subcutaneous injection of these solutions into rabbits.

Dr. Boyland of the Cancer Hospital, London, and Dr. McClean have found the factor which increases the permeability of the tissues in the extracts of rapidly growing transplantable mammalian tumours. The factor is present in an amount proportionate to the rate of growth of the tumour. Extracts of fowl sarcoma No. 1 do not increase diffusion in the tissues. Extracts of Fujinami myxosarcoma, on the other hand, produce

an increased diffusion comparable to that caused by the more vigorous mammalian tumours.

The department for the preparation and study of vaccine lymph has been transferred from Cornwall to Elstree and the bacteriologist is now making an intensive study of the preparation and behaviour on storage of pure suspensions of elementary bodies recovered from vaccine lymph. Dr. Eagles has found that elementary bodies obtained from dermal lapine are highly active after prolonged storage in the cold in suitable fluid media: it is hoped to obtain similar suspensions from vaccine lymph which may be used for Jennerian prophylaxis in man.

Last year we referred to the observations on the relation between tissue permeability and local immunity to infection which have been made by Dr. McClean and also by Dr. Favilli of the University of Florence. The dramatic action of the culture filtrates of certain pathogenic organisms on the permeability of the tissues has added to the interest of the work of Favilli in Italy. Dr. McClean hopes to complete his observations shortly. It appears that the initial fixation of bacteria or other injurious substances at the site of inflammation by means of the reduction of tissue permeability is a protective mechanism which plays a definite part in immunity. A study of the balance between this reaction by the tissues of the host and elaboration of the factor produced by bacteria, which diminishes this protective mechanism, cannot fail to be of considerable interest and importance.

Clinical and other Notes.

MOSQUITO DESTRUCTION BY JAMES' METHOD.

BY LIEUTENANT-COLONEL T. O. THOMPSON, M.A., D.M., B.CH.OXON., D.P.H.OXON.
Royal Army Medical Corps.

IN amplification of the method described by James[1] (1935) for the fumigation of rooms and destruction of mosquitoes as an anti-malaria measure, the following illustrated account of the method in actual practice may be of use in that illustrations are easier to follow and more readily remembered than a word description.

The method has now been in use since 1933 as one of the permanent routine anti-malaria measures employed at Bannu and the illustrations were taken during the routine work in the new cavalry barracks.

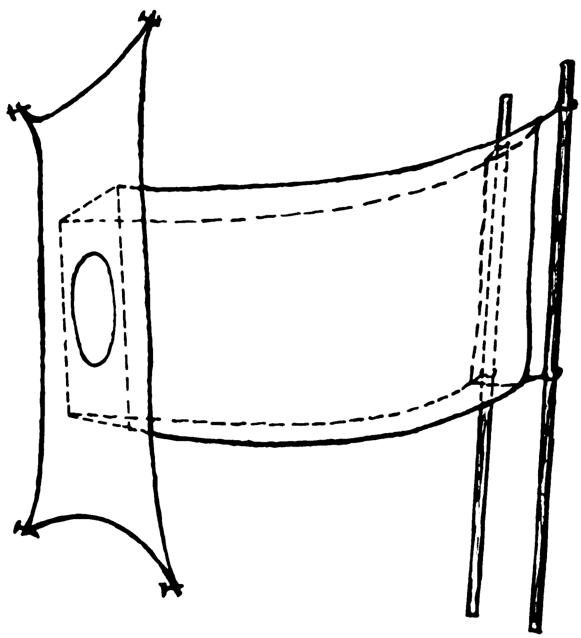


FIG. 1.

The Trap.—This consists of a black cloth, about 6 feet square, in the centre of which is cut an opening 12 to 15 inches in diameter. Stitched on to this black cloth, on the outer side, is a bag of mulmul (a fine gauze

[1] "Fumigation and Trapping of Mosquitoes," by J. F. James, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, October 1935, lxv, 4, pp. 267-269.

cloth) 6 feet long and 2 feet in diameter. This is sewn on at right angles to the black cloth, and has tapes at the distal end for tying to supports which retain the mulmul bag in position.

In the original experiments an ordinary Service brown blanket and an old mosquito net were used; but the present modification is lighter, more easy to handle and to fix in position and is much more economical. The cost per trap is three rupees.

Fig. 2.

The trap is set by stretching the black cloth as a diaphragm over the inner side of the most suitable window by means of tying tapes and nails, and by fixing the mulmul bag through the window to supports placed outside in such a manner that the bag is held open and at right angles to the diaphragm.

Diagrammatic Sketch of Black Cloth, and Mulmul Trap.—Fig. 1 shows the black cloth fixed as a diaphragm across a window and fastened to four nails in the wall, with the mulmul cloth trap open and supported in position by two poles to keep it at right angles to the black cloth.

The most convenient method of support for Indian troop lines is undoubtedly the charpoy.

The Trap Set.—Fig. 2 shows the mulmul bag stretched from the black diaphragm to the supporting charpoy. The windows chosen for the traps face towards the north.

The Trap Entrance (fig 3).—The room is quite dark. The black cloth is in position over this window, which shows as a grey patch in the darkness. The exit hole leading to the trap shows up as a brilliant white mark.

In rooms in which this method is used regularly four stout nails are driven and left in readiness at the corners of the selected window in each room.

Fumigant.—Three or four inches of katol coil are used for each ordinary eight- to ten-bedded barrack room. This is lighted and left hanging on a shelf or nail at the end furthest from the trap.

FIG. 3.

This has proved to be the most effective and economical of the fumigants, and it is harmless, as used, to humans or to equipment.

The stream of mosquitoes which pour out of a room to the lighted opening to escape from this fumigant has to be seen to be believed.

Method of use.—In each barrack room a stout wire is firmly fixed permanently in position over the top of each window and door. These are meant as supports to the blankets which cover the openings.

For each clerestory window a double piece of sacking remains permanently as a blind. This is pushed into position daily for the morning fumigation by means of a pole, or may be even left in position during the mosquito season.

When the occupants get up in the morning the men nearest the windows and doors place their own brown blankets over the wires to cover the windows and doors. This darkens the room except for the trap-window.

The anti-mosquito orderly then comes to the room and places a trap

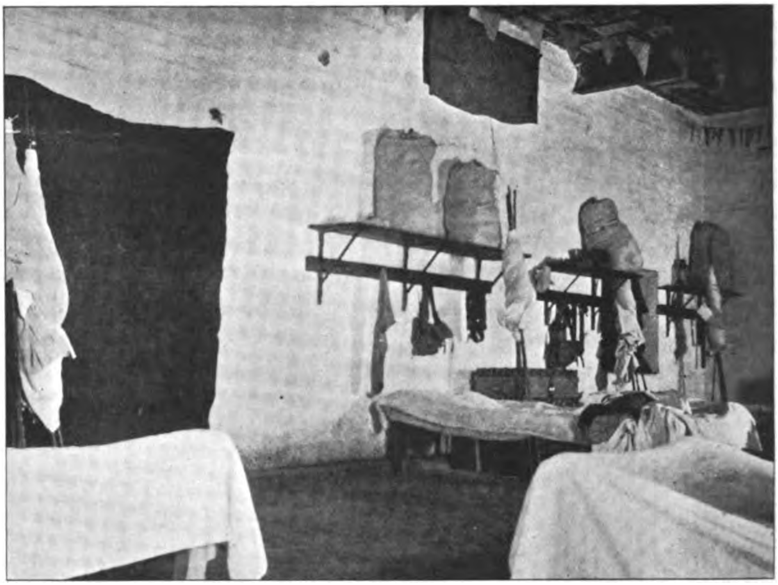


Fig. 4.

over the open window. The unit, name and barrack number are marked on a paper slip and placed in the trap for identification.

Room Prepared for Fumigation (fig. 4).—The orderly lights a katol coil, closes the door and leaves the room for half an hour.

After half an hour the trap is tied off, and the room is opened up. The traps are all collected together, rolled up and sent up to the laboratory

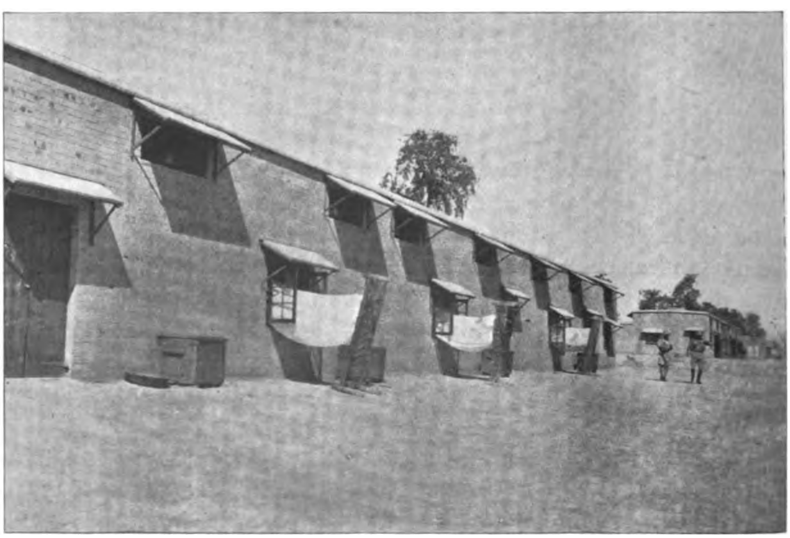


Fig. 5.

for counting and identification of the catch and for killing the hordes of insects which have been caught.

Annual catches have been about 15,000 to 18,000 insects, of which in Bannu a definite majority are anophelines.

The barrack room orderly puts back the men's blankets on to each bed and opens up the clerestory windows. The smell of fumigation soon disappears.

The windows used for trapping should face away from the sun and away from the prevailing wind. All the rooms in one block can be done at one time. The method becomes pure routine for the occupants, the barrack orderly and the anti-malaria personnel.

A Battery of Traps in the Cavalry Barracks (fig. 5).—The north aspect of the barrack block with traps in action on each room is shown in this figure.

My thanks are due to Captain J. W. A. McIver, R.A.M.C., the anti-malaria officer, Bannu, and to the anti-malaria staff who carried out the demonstration.

A NEW LORRY-FITTING FOR STRETCHERS.

By Major F. R. H. MOLLAN, M.C.,
Royal Army Medical Corps.
AND
Lieutenant H. L. FLINT,
Royal Army Service Corps.

When a mechanized brigade operates over a wide front, distances will inevitably be long and the mechanized field ambulance is likely to be dependent on all its transport for the removal of casualties.

To meet this problem the obvious solution appears to be the provision of a conversion set for each lorry. For a mechanized field ambulance this would bring the total stretcher carrying capacity up to 104, as against 32 at present.

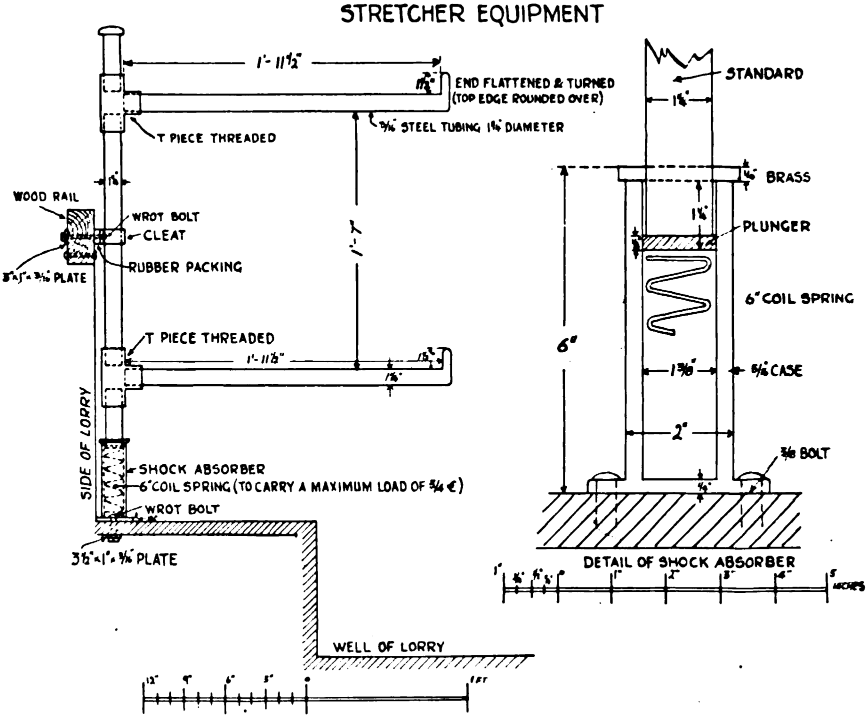
There is no provision for a lorry conversion set in the British Army, and we have devised and had a set made which embodies the following advantages: (i) The utmost possible riding comfort; (ii) easy loading and unloading; (iii) it is instantly available for use; and (iv) it is "foolproof," strong and a permanent fixture with nothing to get lost.

The equipment consists of tubular steel uprights from which protrude two steel supporting arms. The uprights are supported on spring shock absorbers. When not in use the supporting arms are flush along the side of the lorry and held with spring clips. The steel uprights are held in position to the side of the lorry by iron cleats which are mounted on rubber shock absorbers. To bring into action the supporting arms are pulled out at right angles to the side of the lorry and when in this position a stud in

the upright falls into a slot in the cleat to keep the arms rigid. The stretchers are then placed on the supporting arms; the runners on the stretchers and the flanges on the supporting arms prevent the stretchers sliding off. (See diagrams).

We had this equipment fitted to a lorry and gave it an exhaustive trial over rough country—the results were even better than we had hoped for; the riding was surprisingly comfortable, due to the fact that the stretchers are sprung independently of the lorry springs, and so all road shocks are reduced to a minimum. Indeed, our own impressions were that riding was much more comfortable than that provided in the Service motor ambulance!

STRETCHER EQUIPMENT



A lorry fitted with this apparatus would make an excellent travelling dressing station for use under conditions such as are envisaged in R.A.M.C. Training, 1935, para 362. Lighting for this could easily be obtained by a lamp of the "Magnalite" pattern plugged into the dash-board of the lorry. A small Magnalite lamp has been tried out for this purpose and found satisfactory.

It is suggested also that this conversion set would be most useful for converting river steamers and barges into improvised ambulance vessels, and railway rolling stock into improvised ambulance trains.

A lorry can be equipped with the apparatus to carry four lying cases at

a cost of £5 10s.: no modification to the body of the lorry is necessary, and the equipment can be fitted by any carpenter or fitter in half an hour. The apparatus in no way interferes with the normal loading of the lorry.

In our opinion the equipment should be adopted as a standard fitting for the lorries of all medical units.

We wish to thank Colonel R. M. Dickson, O.B.E., Director of Training, Field Ambulance Training Camp, Swingate, Dover, for permission to forward this article for publication.

Echoes of the Past.

WAR EXPERIENCES OF A TERRITORIAL MEDICAL OFFICER.

By Major-General Sir RICHARD LUCE, K.C.M.G., C.B., M.B., F.R.C.S.

(*Continued from p.* 277.)

Chapter XIV.—East Force.

East Force Headquarters was at this time established in a group of small camps close to the village of Deir el Belah and only about five hundred yards from the sea. The Force though not formally recognized as an independent Army unit was practically run as such and the Commander flew the red and blue flag of an Army Commander. As the Commander-in-Chief, Sir Archibald Murray, had his Headquarters at Cairo, Sir Philip Chetwode was responsible for all the troops East of the Canal except those on the lines of communication.

Desert Column, consisting of the two Mounted Divisions and the Imperial Camel Corps with one of the Infantry Divisions attached, was practically an independent subordinate command with much the status of an Army Corps. The Commander flew the red and white flag of a Corps Commander. All correspondence between Desert Column and General Headquarters in Cairo passed through East Force Headquarters. The medical staff of the force consisted of a D.D.M.S. (Deputy Director of Medical Services) with an A.D.M.S. as his assistant and sanitary officer, a medical officer especially devoted to water supplies and a headquarters medical officer who had charge of all Headquarters personnel. The medical staff was not very comfortable as it was pitched on dusty ground close to a road on which there was much traffic and worse than anything it was within a few yards of the Headquarters motor garage. Cars were coming in or going out all day and all night long and we were so constantly subjected to the noises of engine testing that it was often difficult to carry on a conversation. It was, however, an agreeable change to live once more

in a roomy tent instead of in a bivouac tent and a great luxury to have electric light. The first few weeks were for me a strenuous time as there were many threads to be picked up and much new routine work to be learned.

The campaign had settled down very much to a condition of trench warfare.

The Turks held a line more or less unbroken from the sea at Gaza to Beersheba, nearly thirty miles inland. Our front line, about fourteen thousand yards long, was opposite the right part of theirs and extended from the sea to the slopes at Sheik Abbas and was strongly trenched and wired. Eastwards of Sheik Abbas our flank was thrown back across the Wadi Ghuzzeh and rested at its extremity on the old Turkish fortifications at Shellal referred to before.

Desert Column was responsible for the defence of the flank. Opposite Gaza the two lines were only about four hundred to a thousand yards apart, but our extreme flank, thrown back as it was, lay twelve miles from the nearest part of the Turkish lines and twenty from Beersheba. Both sides were fairly quiet and busily occupied in strengthening their defences.

The night of my arrival was, however, signalled by a serious bombing raid on our camps at Deir el Belah. It was a bright moonlight night and taking advantage of this, three or four planes dropped a number of bombs among our camps. The worst sufferers were the two casualty clearing stations near the railway station. Both units suffered severely. One medical officer and fourteen other ranks were killed; three dental surgeons and thirty-six other ranks wounded.

Two nights later a second raid took place and again the hospitals were the chief victims. Four other ranks were killed, three officers and fifteen other ranks wounded.

One of the bombs set fire to the dispensary tent of the 53rd Casualty Clearing Station which was burned to the ground.

The hospitals at the time were showing the regulation distinguishing lights, i.e. two white lights side by side. This distinguishing mark, though official, is not international and not an authorized Red Cross distinction. It was anxiously debated whether this attack on the hospitals was a deliberate breach of the Geneva Convention on the part of the Turks in imitation of their allies or a mistake due to their ignorance of our distinguishing signs for hospitals at night. This was an important matter to decide, as on it depended our future policy. In the moonlight the tents of the hospital even without lights are a good mark from the air but there is no doubt these lights showing would help the aim of the bomb dropper who had deliberate malice in his heart. We had to settle, therefore, whether it were better to show no lights at all or to show others which would be quite unmistakable. Taking into consideration their previous record both in Palestine and at Gallipoli for clean fighting and respect for the Geneva Convention, we decided on the latter policy and inaugurated

a system of marking the hospitals at night by a cross formed of red lamps suspended on wires a few feet from the ground.

Two days later there was another raid and this time the hospitals were spared, so we presumed that our charitable view of their conduct on the previous occasions was the correct one. The system was later extended to field ambulance units when they were filled with patients, and we never had any reason afterwards to regret our decision. Our Air Force reported that these red crosses were quite visible and distinctive at high altitudes. To be on the safe side, however, we constructed shallow trenches or "Funk Holes" all round the tents of the hospitals and organized a scheme for getting the patients moved into them whenever the alarm of air raid was sounded. Another precaution taken at the time was to forbid the use of headlights on the motor ambulances at night. It was doubtful whether it was more dangerous for those in the cars to run the risk of being bombed or to chance being turned over and buried under an ambulance.

A few days later the 53rd Casualty Clearing Station moved back to Rafa so as to reduce the tentage in the forward area and to be more directly available for cases from the Desert Column who now had their own direct route of evacuation to Rafa some distance from the coast.

My first duty as D.D.M.S. was to make a round of visits to the divisions and their medical units and to get into touch with their medical needs.

These visits to the front line were always full of interest, introducing one to new ground, new people and new problems. The ground held by East Force troops as distinct from that held by Desert Column, was divided into two front line sections and a reserve area. Each section was held by a division, while the reserve area was occupied by a third division.

The remaining infantry division was attached to Desert Column and out of the direct administrative control of East Force Headquarters.

The divisions moved round in rotation from one area to another. As it was impossible to see the whole area of a division in a day I used to visit representative sections.

Each division had its little points of difference in sanitary and medical methods. It was our policy at Headquarters, while insisting on uniformity in important principles, to allow as much freedom as possible in the carrying out of details and to hand on successful new methods initiated by any one division to the others for adoption. A great deal was done in this way to stimulate keenness and originality. Weekly conferences were held at Headquarters at which all the divisional A.Ds.M.S. or their representatives were present, and the discussions which took place at them were often most interesting and helpful.

As it was understood that there was no likelihood of active operations being undertaken for some months we were able to devote ourselves whole-heartedly to the medical well-being of the troops and in this we received every possible help and encouragement from our Commander, Sir Philip

Chetwode. With the experience of Gallipoli and Salonica before us the three main problems were the prevention of dysentery, malaria, and typhus. Experience had shown us that with properly inoculated troops enteric was not a serious danger. Dysentery depends on the fly and the disposal of excreta. Malaria on the mosquito. Typhus on the body louse. Fortunately we had at the disposal of the Force a first rate practical entomologist in Major Austen of the British Museum. His knowledge of the habits of our enemies and of the best methods of tracking them down was invaluable. He was entrusted with a roving commission to inspect and advise on all work undertaken to combat these pests. Sometimes he was attached to East Force and sometimes to Desert Column Headquarters.

As regards dysentery the details of the plan of campaign had been worked out during the previous year in Egypt by a special committee. The great object before one was to prevent flies from breeding and to deny access of those that existed to excreta infected with dysenteric germs and to food materials.

The first principles were therefore:—

(1) To use bucket latrines with fly-proof seat covers, whenever these could be obtained.

(2) To destroy the bucket contents by fire, or when this was impossible to bury them in deep pits and covered over so as to be inaccessible by flies.

(3) To burn all food and other organic refuse in which flies could breed, or when this was not possible to bury it in pits which were to be sealed, as soon as full, with sheets of Hessian cloth or Hessian and paper in such a way that the adult fly emerging from the pupa which had wriggled to the surface of the pit, found itself shut down beneath an impermeable sheet which soon became its pall.

(4) To bury dead animals well away from camps and trench quarters.

(5) For all troops to carry on an active campaign against the adult fly itself.

(6) To protect all food-stuff from access by the fly by the use of fly-proof larders and gauze wraps.

(7) To burn horse manure or spread it in a layer not more than one inch deep over a wide smooth area, to dry in the sun.

Every effort was made to teach the troops and their officers, and by a system of regular inspections to ensure as far as possible that regulations were carried out and a proper sense of sanitary discipline developed throughout the Force. It is idle to maintain that fly-breeding ceased as the result of our efforts, but in Palestine the numbers of flies never approached the proportions reached at Gallipoli, and in fact, they rarely became a serious plague in areas controlled by well-disciplined units. The better divisions by constant work kept their lines wonderfully free. Dysentery and diarrhœa never assumed epidemic proportions.

As regards malaria we started with very little knowledge about the prevalence of the disease in this part of the country which had been little frequented by tourists and travellers. We knew, however, that parts of central and northern Palestine had a very evil reputation in the summer and autumn months.

As the female mosquito lays her eggs on the surface of still water and the larvæ when hatched live in it, breeding can only take place where water is present and the water supplies of southern Palestine in the summer and autumn are strictly limited ; for there is no rainfall from May to October. It was not difficult, therefore, to discover if mosquitoes of the dangerous kinds were present in sufficient numbers to cause anxiety.

The only sources of water that we had to deal with in this area were : a lake at Deir el Belah, the water of which was distinctly brackish, and increasingly so as the water dried up during the summer ; a series of wells in and around the villages ; springs and pools in the Wadi Ghuzzeh and the shore water beneath the sand referred to above. The sea itself was thought at first to be above suspicion, and for practical purposes I believe it was free from danger, but breeding was found on a few occasions to be taking place in quiet pools of sea-water by the shore. The mosquito larva does not, however, like moving water and the constant breaking of the waves into the pools probably prevents the sea from being a serious source of breeding.

Anopheles larvæ were found in all the other surface water supplies, especially in the shallow stagnant pools of the Wadi.

Extensive schemes were put on foot to deal continuously with the breeding places, and so effective were the measures taken that by the late summer Major Austen found it quite difficult to find specimens in places where earlier they had been rampant. The result was that during the summer of 1917 there was little malaria among the troops.

It is now almost definitely established that typhus fever is conveyed to man by the bite of a body louse which has previously bitten a subject infected with the disease.

As regards typhus prevention, we had the benefit of the experience that had been gained in Serbia during the terrible epidemic of 1915. We adopted the great invention of the Serbian Force, the disinfecting train. This consisted of a locomotive engine and two or three closed trucks fitted with racks on which the entire kits of about six hundred men could be deposited at one time. Steam was conveyed in great force and volume from the engine into all the trucks simultaneously, and rapidly destroyed all the lice and their eggs exposed to its action. We had four trains of this kind with a permanent staff attached to each. A train could be moved up to any spot near the troops, and by this means a whole regiment could be disinfected in a single morning. One train was reserved entirely for men of the Egyptian Labour Corps. Endeavours were made to ensure that every unit was disinfected about once in six weeks, and in this way

the plague of lice was kept under control and the risk of a typhus epidemic reduced to a minimum.

Other diseases which gave anxiety were cholera, relapsing fever, diphtheria, scarlet fever, and sandfly fever. The small epidemic of cholera which occurred in August, 1916, after the capture of Katia has already been referred to. The infection undoubtedly came from the Turks, who had had a number of cases.

In June, 1917, we had an isolated case in an Egyptian of the Labour Corps in which the vibrio of cholera was definitely isolated. It caused us considerable anxiety and led to a temporary enforcement of strict regulations as to the movement of troops and civilians up and down the line and across the Canal into Egypt. Fortunately there was no spread at this time.

Relapsing fever occurred occasionally among the Egyptians, but in 1917 we had little or no trouble with this disease among the British troops. As in the case of typhus, for prevention of this disease we relied on regular disinfection of clothing.

Diphtheria and sore throat caused a good deal of trouble in the trenches, though they never became epidemic. Cases of diphtheria, though fairly common, were almost always confined to individuals and rarely spread to contacts.

An interesting piece of work was done by one of our bacteriologists at the laboratory attached to the 54th Casualty Clearing Station on the connexion between septic sores and diphtheria. In numerous cases he isolated from the discharge of the sores a bacillus which could not be differentiated from the Klebs-Löffler bacillus of diphtheria. I do not know if he ever had the opportunity of completing his investigations, but the extreme chronicity of these sores and their resistance to local treatment bears a distinct resemblance to some recognized forms of diphtheria infection, such as that of the eyelids. Almost my first recollection of General Allenby is the occasion when we tried to demonstrate to him, with a microscope, the Klebs-Löffler bacilli in a specimen from one of these cases. It was in the laboratory of the 54th Casualty Clearing Station during his first visit to the Palestine front on July 6, 1917.

Cases of scarlet fever cropped up in a curiously sporadic way during the summer, but this again was never epidemic.

In July and August we had a definite and extensive epidemic of sandfly fever. The disease runs a course clinically not very different from influenza, though fortunately without its sequelæ. The habits of the fly are not well known, but it is supposed to like dark and shady spots and has been thought by some to have a relation to lizards. We found, at any rate, that the troops attacked by it were those quartered near villages or in ground enclosed by hedges and palm trees. We found the way to stamp out an epidemic was to move the troops out into the open plain or desert.

This outbreak, though in no way serious, caused a certain amount of

trouble and anxiety because it occurred just at the time when the Force was being reorganized and undergoing special training for the new operations which were to take place in the autumn. An affected unit was temporarily placed *hors de combat* and could not be counted on to do any work until the epidemic was over. The majority of cases were treated in their lines, but the more serious had to be admitted to field ambulances, instructions being issued not to send them down the line if it could be helped.

To deal with the septic sore and other minor complaints not really requiring hospital treatment, a convalescent camp was established on the beach at Rafa. The exact military status of this camp caused a good deal of discussion. The point was, whether it was to be a medical unit under the protection of the Red Cross, or a military rest camp with a medical unit attached to carry out any special treatment that was needed. Eventually the latter principle was decided on. The camp was put under a military commandant but one of the immobile sections of the Field Ambulance of the 74th Division was attached to it and the Commanding Officer of this medical unit, though not responsible for discipline, was given special powers for regulating the administration of the camp and for dealing with the medical aspect of the cases sent there.

Under these conditions in which sea bathing formed a large part of the treatment, the septic sores made good progress and the camp fulfilled a very useful function.

Desert Column had a similar camp on the coast between Belah and Rafa for their cases.

The 53rd Division opened a special hospital on the beach, near the mouth of the Wadi Ghuzzeh, for scabies cases of which there were a great number in that division. They found it very difficult to eradicate this disease from the community, and by no means easy to cure it in the individual, even when the case was under complete medical control with every facility for bathing, washing, disinfection and regular treatment.

I have seen it stated by confident dermatologists that scabies can be cured in two to three days by careful treatment, but this certainly is not true of the cases we had to deal with. Even four to five weeks does not always suffice to make a definite cure in a bad case.

The organization of field ambulances into mobile and immobile sections has already been referred to, especially in relation to the mounted field ambulances. The Infantry Field Ambulances of the Infantry Divisions had two mobile sections and one immobile.

The three immobile sections of a division were about this time organized into a single unit without however in any way altering their official establishment. In accordance with the wish of the Force Commander the immobile sections of all the divisions were grouped together on a site near the 54th Casualty Clearing Station and were used for the reception of light cases from their own divisions so as to relieve the base hospitals.

The two casualty clearing stations, the 54th at Belah and the 53rd at Rafa, were unable from their establishment to do more than fulfil their function of clearing cases from the front. It was impossible for them to retain cases and send them back cured to their unit. Once men go down the line it is very difficult to get them back, even though their original disabilities may have been slight ones. Every effort, therefore, was made during this long period of quiescence to save the wastage which evacuation down the line involves.

The Immobile Section Divisional Hospitals fulfilled a very useful function in this way. It was necessary, of course, to obtain for them a special scale of equipment to ensure the satisfactory treatment of patients and the requisite standard of comfort.

The main dressing stations of the field ambulances stationed nearer the line were used to some extent in the same way.

One of the grouped immobile sections, that of the 52nd Division, was opened as a special hospital for the segregation and treatment of diphtheria and diphtheritic carriers, and did most useful work.

On June 4, East Force Headquarters moved into a new camp which had been prepared for it on the coast about a mile South of Belah. The sand dunes there are narrow and only about thirty feet high. Into this sand cliff facing the sea terraces were dug and out of these terraces quarters were constructed for all the messes and also for the officers of the staff. They were dug into the side of the cliff, revetted and fronted with sandbag walls and roofed with timber and corrugated iron.

For residence in the heat of summer, the position was ideal. Within a few yards of the sea, over which they looked out from a height of twenty to thirty feet, they received every bit of the breeze, which in normal times came off the sea every day. Bathing could be indulged in at one's very door, though it was hardly safe on this coast except in very calm weather. When there is anything of a swell the currents are very strong and there is an outlying reef of submerged rocks against which bathers are very apt to be dashed. During the summer there were several fatalities from bathing.

Attached to the Force, but at this time employed on the line of communications at Khan Yunus was a small French detachment of colonial troops. They were entirely self-supporting medically, having their own base hospital in Egypt and their own field hospital at Khan Yunus. All we had to do for them was to give them railway facilities for evacuation.

Our relations with the French medical officers were most cordial and a visit to their pleasant camp in an orchard at Khan Yunus, with its warm welcome and open hospitality, was a pleasure to be looked forward to and held in happy remembrance afterwards.

These French detachments were equipped for mountain warfare with mule litters for the carriage of the wounded. Each mule carried a pair of litters which when occupied must have weighed well over three hundred and

eighty pounds, too big a load for a mule, we should think, but the animals seemed to get along all right. Their hospital tents were of an excellent light pattern, lined with a cool blue colour which formed a refreshing relief from the glaring sun.

Though there were no active operations going on during the summer months, the autumn with the coming offensive was ever before us, and much care and thought was bestowed on the organization of our methods of evacuation of wounded in preparation for active operations, offensive or defensive.

Sites for dressing stations, advanced dressing stations and first-aid posts were carefully selected and protected, as far as possible, with head cover from shrapnel.

The routes up to the dressing stations were surveyed and made practicable for motor ambulances by laying down wire netting where necessary.

Regular inspection of these routes and seeing that they were kept in order formed an important part of my duty.

General Chetwode made a great point of saving the motor ambulances during periods of inactivity as they were limited in number and could not be replaced. They were, therefore, kept concentrated in the charge of a special R.A.S.C. officer, under direct control of the D.D.M.S., and only used for serious or urgent cases.

The ordinary routine evacuation of sick was carried out by means of camels and sand carts. By this means the cars were saved and the mules and transport drivers kept exercised.

For emergencies, one or two cars were always on duty at convenient points on each route.

Of the motor ambulances at our disposal, in the proportion of seven for each field ambulance, about half were Ford cars capable of taking two lying patients each or four sitting. The remainder were either Wolseleys, Studebakers or Sunbeams, each able to take four men lying, or twelve sitting. The Fords had their special uses as they could travel over rough and sandy ground which completely defeated the heavier cars.

About the middle of June we had a visit from Lieutenant-General Lawson, who had come out from England to deal with the question of man power. His plan was to take as many able-bodied men as he could from the R.A.M.C. and replace them with men of class B. We made an absolute stand against the men of field ambulances being replaced, as their work during active operations is no whit less arduous than that of the fighting ranks. This point was conceded but we had a number of our R.A.S.C. drivers replaced by Egyptians. It was arranged that to each team of four animals there should be one British and one Egyptian driver. This system worked well and we rarely had any trouble with our Egyptians. They were hard working and with the support of their British comrades they never showed any lack of courage.

Chapter XV.—Arrival of General Allenby.

General Allenby came out to relieve Sir Archibald Murray at the end of June. He paid his first visit to East Force on July 6. All the heads of departments went to meet him at the station at Deir el Belah and I for one did not fail to be impressed with the great personality that had come out to control our destinies.

The 60th Division, the first of our new divisions, began to arrive on the same day from Salonica, where they had only spent a few months without taking part in any active operations. They were a second line London Territorial Division commanded by Major-General Bulfin.

The 75th, a mixed British and Indian division which was being formed on the Canal, came up about a month later. Its British regiments were some Wessex territorial battalions from India and some regulars from East Africa. Most of the Indian troops had been serving in Mesopotamia. The troops from East Africa were terribly infected with malaria, in some cases so badly that they could not take the field when the division first came up.

During the summer a branch line was constructed from Rafa to the right part of our line. It made its way through the old Turkish defences to the crossing over the Wadi Ghuzzeh at Shellal and was carried across the bed of the Wadi, up the escarpment on the other side and about a mile out into the plain beyond. The working at this point, however, was shelled so heavily from the Turkish position at Hareira that it was decided to take up the piece that had been constructed beyond the Wadi. No doubt the taking up of the rails was done partly to deceive the Turks as to our future intentions. At the same time another branch was contined along the south side of the Wadi as far as Gamli, the extreme right of our line.

As soon as these branches were completed they were used for evacuation of casualties. In the meantime the Sinai part of the line from Kantara to El Arish was gradually being doubled. To get the troops into proper fettle for coming events after their long inactivity, a couple of raids were organized and carried out on the coastal section during the month of July. Both were directed against outlying positions held by the Turks near the coast in front of Gaza. Both were successful, and on each occasion prisoners were taken and only a small number of casualties incurred. These raids also served to test our scheme of medical evacuation which proved quite satisfactory.

With the arrival of General Allenby and the new divisions, came rumours of reorganizations at headquarters. These rumours gradually materialized into definite news. The Commander-in-Chief was coming to Palestine with his headquarters to take over command of the Army in person. East Force was to be abolished and the Army divided into three Army corps, two of infantry to be called the 20th and 21st, and one of mounted troops. General Chetwode was to command the 20th and General Bulfin the 21st. The mounted corps was to retain its old purpose

and to be called the Desert Corps instead of the Desert Column, General Chauvel retaining command. It was now, however, to consist of three divisions each of three brigades. The new divisions were to be known as the Anzac, the Australian, and the Yeomanry Divisions. In the change I remained with General Chetwode and became D.D.M.S. of the 20th Corps, and my A.D.M.S., Major Lelean, stayed with me as D.A.D.M.S. The Corps was to consist of the 53rd, 60th and 74th Divisions, and the 10th Division (Irish) when it should arrive from Salonica.

A large camp was prepared for General Headquarters at Kelab on some open ground near the railway between Rafa and Khan Yunus.

The D.M.S., General Maher, did not at first come up to Kelab with the rest of the G.H.Q. staff, but sent his A.D.M.S., Colonel Keble, to represent him.

East Force did not become extinct until August 12. At this time the 53rd Division was in the trenches on the coastal section and the 60th was attached to Desert Column, so that when the 21st Corps took over responsibility for the maintenance of the lines opposite Gaza the 74th Division was the only one of our divisions which for the moment was under our control, and as they were going through a special course of training our immediate responsibilities were very light.

Twenty-first Corps Headquarters moved into our terraced quarters on the beach and we formed a temporary camp in Deir el Belah near where we had been before, until a new camp which was being prepared for us at Fukhari, on the Rafa-Shellal railway, was ready. After the strenuous work of East Force our duties were very light, and the opportunity was seized by most of us for taking a short holiday. My own, the first since our landing in April, 1915, was spent in Cairo, where, after the manner of the traditional busman, I took the opportunity of seeing something of the work in the base hospitals.

(*To be continued.*)

Current Literature.

The Influence of Diet on Caries in Children's Teeth. Medical Research Council. Spec. Rep. Series, No. 211. H.M. Stationery Office, 1936. Pp. 137. Price 2s.

The results obtained during the first stages of the investigations described in this report were published in an interim report issued by the Medical Research Council in 1931 (Spec. Rep. Series, No. 159). The report under review gives a complete description of the investigations, the methods employed and the detailed results.

The object of the investigations being to determine to what extent it was possible to control the initiation and spread of caries by dietetic measures

during the period of development and after the eruption of the teeth, the main line of the experiments consisted of adding various substances to the basal diets of children between the ages of 5 and 14 years living in three institutions in Birmingham, the amounts of the added substances varying with the ages of the recipients (Investigation I). These additional substances were treacle in one institution, olive oil to which a small quantity of iodine was added in another and cod-liver oil in the third.

Six months after the investigations began it was found possible to subdivide the children in the largest of these communities into two groups, one of which was given olive oil and the other olive oil to which vitamin D in the form of irradiated ergosterol was added (Investigation II).

Children in the institutions between the ages of 2 and 5 years and some twenty-seven under 2 years in a nursery home were also given the diet additions, those in the nursing home being given irradiated ergosterol. The observations on this special age-group are recorded as Investigation III.

The total number of children dealt with in the three institutions was about 1,600, but of these only a small proportion were under observation for the whole period of three years. Each child was given a thorough examination at the beginning of the test period and thereafter at six-monthly intervals until the end, special attention being paid to the surface structure of the teeth, their arrangement in the jaws, the number of teeth carious and the extent of the caries in each, the condition of the gums and lastly the general physical condition, particularly with regard to the bones.

No definite evidence was obtained from the observations on the effects of diet on the structure of the permanent teeth, but Investigation III gave indications that the addition of vitamin D to the diet during the period of development improves the structure of the first permanent molars.

On the other hand, very definite evidence has been found that when an increased vitamin D supply is given before the full eruption of the teeth, there is a very significant decrease in the incidence of caries after eruption.

The beneficial effect of increased vitamin D given after full eruption of the teeth was not clearly evident as a result of Investigation I, but in Investigation II it was quite definite, and the conclusion can be arrived at that the best results are obtained with the permanent teeth when the increased vitamin is given during the pre-eruptive period.

In considering the data collected for the deciduous teeth, it is pointed out that the average ages of the children at the beginning of Investigations I and II were 9½ and 10 years respectively, so that in many cases absorption of the roots would be taking place and the circulation in the pulp would be disturbed, therefore any direct nutritional effect would appear to be less likely to occur. Nevertheless, it was found that there was less initiation and spread of caries in the cod-liver oil group than in the treacle group, although there appeared to be little or no difference between the cod-liver oil and olive-oil groups.

In Investigation III there were so few children in the olive-oil group that comparisons are impossible, but as regards the other two groups there is definite evidence that caries was less progressive in the cod-liver oil group than among those being given treacle.

In view of the belief still held in some quarters that caries begins in a tooth because certain bacteria produce acids by fermenting carbohydrates adhering to the enamel, a comparison of the onset and spread of caries in the treacle and olive-oil groups is of interest. So far as the original permanent teeth of each group are concerned, the incidence of fresh caries was the same, but the spread was significantly greater in the olive-oil group in which there was also apparent a more marked degree of softening of the carious areas. In the newly-erupted teeth the incidence and extent of the caries were found to be distinctly less in the olive-oil group. The conclusions to be drawn from this phase of the investigations may, however, be obscured because the facts only became apparent in the last six months of the observation period, and during this time the olive-oil group showed a greater number of fully-erupted teeth. In addition, the small amount of iodine given with the olive oil may also have had some unknown effect on the final picture. In any case, the investigators are of opinion that a more completely controlled investigation will be necessary before the relative effects of treacle and olive oil can be correctly assessed.

The effects of the diet additions on the general physical condition of the recipients are for various reasons not so definite as those on the dental tissues, but it is noted that signs of healed or active rickets have been reduced to a greater extent in those receiving cod-liver oil than in the control groups.

It is also noted that no evidence was obtained that the addition of cod-liver oil for three years (Investigation I), or vitamin D in the form of irradiated ergosterol for two and a half years (Investigation II), had had any effect in promoting greater increases in height and weight. Cod-liver oil did, however, cause a definite reduction in the incidence of catarrhal conditions in colds.

The final conclusions reached are that a relatively high vitamin D content of the food can do much to diminish the incidence of caries if the vitamin is given during the development of the teeth; that a beneficial effect may be obtained if the vitamin is given at a fairly late stage of development; and that even when it is given after the eruption of the teeth the onset and spread of caries are delayed.

PETTIT, H., MUDD, S. & PEPPER, D. S. **The Philadelphia and Alaska Strains of Influenza Virus. Epidemic Influenza in Alaska, 1935.** *J. Amer. M. Ass.* 1936, v. 106, 890-92, 1 map. [13 refs.]

Influenza appeared in South-eastern Alaska in the autumn of 1934 and worked its way westward and northward throughout the winter. It seems probable that the epidemic was imported from the United States, *via*

Seattle. Virus was obtained from several of the cases and has been examined by Françis [*Bulletin of Hygiene,* 1936, v. 11, 150], who found it to be immunologically identical with the viruses obtained from cases in Philadelphia and Porto Rico. These viruses, in their turn, have been shown to be immunologically identical with the strains of virus originally isolated in England by Laidlaw, Andrewes and Smith [*Bulletin of Hygiene,* 1936, v. 11, 329]; and a strain of virus isolated by Burnet in Australia has been found to be identical with the English strain [*Bulletin of Hygiene,* 1936, v. 11, 330]. It would seem, therefore, that the virus that has been responsible for outbreaks of influenza during recent years, in widely separated parts of the world, is an immunological entity; and this is encouraging from the point of view of ultimate control.

W. W. C. Topley.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 8.

Heukelekian, H. & Schulhoff, H. B. **Studies on the Survival of *B. typhosus* in Surface Waters and Sewage.** *Bull. N. J. Agric. Exp. Sta. No.* 589. 1935, 32 pp. [Summary taken from *Dept. Scient. & Indust. Res. Water Pollution Research. Summary of Current Literature.* 1936, v. 9, 123.]

A study was made of the survival of *B. typhosus* in different artificially infected substrates, its presence in sewage and its survival in sewage treatment processes. Brilliant green agar was used for determining the numbers of *B. typhosus.* It was found that the rate of decrease of *B. typhosus* in polluted water and sewage was rapid. The rate of decrease was greater at temperatures of 22° C. and 37° C., than at 2° C. With favourable temperatures and in the presence of a food supply an actual increase may occur. This increase does not necessarily result in an increase in the survival time as the rate of decrease after the multiplication stage is greater. *B. typhosus* survives for shorter time in polluted than in unpolluted waters probably because of competition for food from other bacteria and attack by protozoa. The survival time is reduced by aeration. The survival time of *B. coli* is unaffected by the presence of *B. typhosus.* In the presence of a food supply the survival time of *B. typhosus* is reduced by introduction of *B. coli.* When normal domestic sewage is sterilized by heat and infected by *B. typhosus* there is a rapid initial increase which does not take place in the presence of certain industrial wastes. There is a rapid reduction in the number of *B. typhosus* during sludge digestion. In activated sludge-sewage mixtures there is an initial increase followed by a rapid decrease. When artificially infected sewage is partially chlorinated the rate of destruction of *B. typhosus* is of the same order as that of normal sewage flora. When 25 per cent of the chlorine demand is satisfied over 99 per cent of the *B. typhosus* are destroyed in ten minutes contact time.

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FRANCIS, T., Jr. & MAGILL, T. P. **The Incidence of Neutralizing Antibodies for Human Influenza Virus in the Serum of Human Individuals of Different Ages.** *J. Exper. Med.* 1936, v. 63, 655-68, 2 charts. [11 refs.]

The authors have tested 136 human sera for their power to protect mice against a strain of human influenza virus. The number of sera coming from any one age group was relatively small but the results indicated that neutralizing antibodies were present in a very high proportion of sera at all ages except during the period between the end of the first month of life and the end of the first year. There was a suggestion that the proportion of protective sera increased slightly from the first year onward, at least until the 40th year; but the numbers were too small to be more than suggestive in regard to this point. The sera of all of eleven newborn infants contained protective antibodies. The noteworthy fact, in relation to the results recorded by Shope in the following paper, is the presence of neutralizing antibodies in the majority of sera obtained from children in the age group 1-10, indicating that natural immunization against the human influenza virus has been occurring freely during the past ten years.

W. W. C. TOPLEY.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 8.

SHOPE, R. E. **The Incidence of Neutralizing Antibodies for Swine Influenza Virus in the Sera of Human Beings of Different Ages.** *J. Exper. Med.* 1936, v. 63, 669-84, 2 figs. [18 refs.]

The author has examined 124 of the 136 sera tested by Francis and Magill (*supra*), and has determined their neutralizing power for swine influenza virus. As in the tests with the human influenza virus, the great majority of sera from adults, or from newborn infants, contained neutralizing antibodies; but a sharp contrast was found in the behaviour of sera from children under 12. Very few of these had any significant protective effect against the swine influenza virus; and it would appear that antibodies to this virus have not been freely acquired by human subjects during recent years. These results are in accord with the small series of tests recorded in England by Andrewes, Laidlaw and Smith [*Bulletin of Hygiene*, 1936, v. 11, 329], and support the view, tentatively advanced by Laidlaw [*Bulletin of Hygiene*, 1935, v. 10, 537], that the swine influenza virus may represent the type of virus that caused the human pandemic of 1918-1919.

W. W. C. TOPLEY.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 8.

F. FAIRLEY, E. C. LINTON and A. H. FORD-MOORE. **Note on the Toxicity to Animals of some Oxidation Products of 1 : 4 Dioxan.** *Journ. Hygiene*, xxxvi, 3, 341; August 6, 1936.

This paper continues an earlier study by the same workers on the toxicity to animals of 1 : 4 dioxan (*Journ. Hygiene*, xxxiv, 486).

The authors show that the oxidation products, *in vitro*, of 1 : 4 dioxan

are diglycollic and oxalic acids, and they report some experiments, carried out at Porton, in which sodium oxalate and sodium diglycollate were given intravenously to rabbits, and ethyl oxalate applied to the skin of rabbits and guinea-pigs. The resulting lesions were comparable with those produced by 1 : 4 dioxan, and the authors suggest that the toxicity of the latter compound may be due to its oxidation to oxalates and diglycollates in the tissues.

Henry Lester Institute of Medical Research.—Annual Report, 1935.

The Henry Lester Institute of Medical Research, which has its headquarters in Shanghai, consists of a Clinical Division, a Division of Physiological Sciences, and a Division of Pathological Sciences. The work of these divisions is, where necessary, correlated by a Central Directorate and assisted by a special Statistical Department. This latter department also undertakes independent investigations. A Department of Scientific Photography is being developed.

The Clinical Division has devoted its attentions largely to infant nutrition and deficiency diseases, particularly the beri-beri syndrome and the chemical changes in the blood, urine and cerebrospinal fluid which occur in this condition. The accumulation of carbonyl compounds—particularly pyruvic acid—is believed to provide a test for detecting early cases of vitamin B_1 deficiency.

The Division of Physiological Sciences has continued its study of nutrition by investigating and analysing various Chinese diets. Experiments of a promising nature were made with soybean egg powder as a substitute for milk in infant dietary.

In the Division of Pathological Sciences many interesting questions have been investigated.

Experiments were made with the much discussed "B.C.G." strain of the tubercle bacillus. A proportion of the experimental animals on which it was tested developed tubercular lesions, and it is concluded that "B.C.G. is certainly not permanently avirulent and it would be highly inexpedient to advocate its use for human prophylaxis at the present juncture."

Bacterial flagella were studied by culturing the organisms in a medium rendered viscid by gum acacia. The movements of the flagella were retarded and could be observed by dark-ground illumination.

"O" agglutination tests gave 100 per cent positive results in cases of bacteriologically proved typhoid fever. "H" agglutination gave 90 per cent positives in the same cases. In seventy cases of "clinical" typhoid fever in which typhoid bacilli could not be found in blood, urine, or fæces, fifty-seven gave neither "H" nor "O" agglutination. The remaining thirteen cases gave "H" but not "O" agglutination. The patients were of course uninoculated, and these results form an interesting contrast to those obtained in our inoculated Army patients, where the picture is by no means so clear cut.

Twenty-four cases of typhoid fever were treated with serum prepared from virulent "O" resistant strains of *B. typhosus*. The results are said to be encouraging.

Numerous interesting observations on helminthology and entomology are made.

These are but a few of the many items of interest in this Report, which obviously emanates from a keen Institute working in surroundings where subjects for investigation are many and varied.

Reviews.

EMERGENCY SURGERY. Second Edition. By Hamilton Bailey, F.R.C.S. Bristol: John Wright and Sons, Ltd. 1936. Pp. x + 842. Price 50s. net.

This very useful book now appears in one volume, and the new edition seems likely to increase the good reputation which the work secured on its first appearance. The letterpress and illustrations are of high quality. Some sections have been entirely rewritten, and the whole volume now presents in first-class form a very complete account of emergency surgery.

The systematic arrangement of the chapters is excellent, and it is easy to refer to the commoner emergencies of any particular region of the body.

The chapters on intestinal obstruction, strangulated hernia, and the kidney, bladder and urethra are particularly good. The treatment of injuries to the spine is thoroughly up to date. There is also an excellent account of the important subject of injuries and infections of the hand.

The book certainly fulfills its object of being a guide to the comparatively isolated surgeon who is called upon to treat a patient stricken with an urgent surgical condition. It will therefore make a special appeal to surgeons in the Services, to whom it can be confidently recommended.

B. B.

THE MEDICAL ANNUAL, 1936. Editors: H. Letheby Tidy, M.A., M.D.Oxon., F.R.C.P.; and A. Rendle Short, M.D., B.S., D.Sc., F.R.C.S. Bristol: John Wright and Sons, Ltd. London: Simpkin Marshall, Ltd. Pp. xcv + 624. Price 20s. net.

The Medical Annual of 1936 maintains its usual high standard in presenting a record of the new and important works of the preceding year.

Sir Walter Langdon-Brown contributes various articles, including one on the cortical hormone and Addison's disease. Mr. Rendle Short writes on the surgery of the adrenal gland and various abdominal conditions.

Sir Leonard Rogers reviews the literature on tropical diseases, including amœbiasis and its treatment with carbarsone, ankylostomiasis and the effect of tetra-chlorethylene alone or combined with oil of chenopodium.

A most useful summary of the recent extensive investigations on anæsthesia is provided by Dr. Blomfield, including the recent views on ether convulsions. Dr. A. G. Gibson writes on various diseases of the heart and blood-vessels and discusses the question of thyroidectomy in cardiac failure.

Professor Stanley Davidson contributes articles on anæmia and blood diseases and sets out the recent views on the treatment of hæmophilia, including the use of *Russell's viper* venom locally and *mocassin snake* venom intradermally or subcutaneously.

Diseases of the chest from a medical point of view are clearly dealt with by Dr. L. S. T. Burrell, and from the surgical aspect by Mr. Tudor Edward.

Dr. Macdonald Critchley writes on recent work on diseases of the nervous system.

There are so many interesting branches of medicine and surgery dealt with that it is only possible to refer to a very few of these.

The book is one that should be on the shelf of every medical man or woman who has not found it possible to keep abreast of the current literature, an almost impossible task these days. A. G. B.

OPERATIONS OF SURGERY. Vol. I. By R. P. Rowlands, F.R.C.S., and P. Turner, F.R.C.S. London: Messrs. J. and A. Churchill, Ltd. 1936. Pp. x + 1045. Price 36s. net.

The appearance of a new edition of this famous textbook is always an event in the surgical world, and it has been a pleasure to read through the first volume of the present (eighth) edition. British surgery has suffered a great loss in the untimely death of Mr. R. P. Rowlands and we can congratulate Mr. P. Turner on the way he has been able to shoulder the responsibility of bringing out the volume under review. The whole book has been carefully revised and much has been re-written. A vast amount of information is again presented, and the new work retains the charm of the former editions in being eminently readable.

Volume I deals with operations on the upper extremity, the head and neck, the thorax, the lower extremity and the vertebral column. Though the special departments of surgery are adequately dealt with, the work is designed especially for the general surgeon, and apart from general surgery, only emergencies and certain important and well-established operations, such as the general surgeon may be called upon to undertake, especially in remote and isolated districts, are described.

As in former editions a good deal of space is devoted to indications for and against operations, and special attention is directed to possible pitfalls, errors and difficulties which beset the path not only of beginners, but also of the most experienced.

The volume is very great value for its modest price of thirty-six shillings, and it may fairly be said to be indispensable to every practising surgeon.

B. B.

A TEXTBOOK OF MIDWIFERY IN THE TROPICS. By V. B. Green-Armytage, M.D.Bris., F.R.C.P.Lond., F.C.O.G. (Lieutenant-Colonel, I.M.S., Ret.), and P. C. Dutta, M.B.Cal., F.R.C.S.Edin., Captain, I.M.S. Second Edition. London: Messrs. Butterworth and Co. (India), Ltd. 1936. Pp. xiii + 447. Price 12s. net.

The first edition of this book appeared in 1932, and the fact that a second edition has been called for in so short a time indicates that it has been appreciated.

It contains a full account of modern western methods in midwifery, together with a large amount of most useful information concerning the modifications rendered necessary by the conditions of life in the tropics, which is not available in any other textbook.

There is a very complete account of acute osteomalacia. a subject which is very briefly treated in most textbooks, and a most useful chapter on the various fevers in the tropics which may affect women in pregnancy and the puerperium.

The authors are firm believers in the advantages of the lower segment Cæsarean operation in the tropics and this is very fully described and illustrated.

The style is staccato and the information is in tabulated form, the authors stating that they find this of advantage to their students, to the majority of whom English is a foreign language.

It also facilitates ready reference in cases of emergency. The number of illustrations is small, this being the deliberate policy of the authors, but it appears likely that this will to some extent impair the usefulness of the book, especially in the earlier anatomical sections which the student will find easier to understand with the help of illustrations.

The general get-up is good and the volume of handy size; it can be recommended confidently to those who are called upon to practise midwifery in the tropics or elsewhere. E. C. L.

VASCULAR DISORDERS OF THE LIMBS. By Sir Thomas Lewis, C.B.E., F.R.S., M.D., D.Sc., LL.D., F.R.C.P. London: Macmillan and Co., Ltd. 1936. Pp. xi + 111. Price 6s. 6d.

There is decidedly a place of welcome in medical literature for this volume from the pen of so distinguished a writer. Vascular disease of the limbs is met with very frequently in present-day practice, and our knowledge of the subject has vastly increased in recent years. The author's own researches have contributed very largely to this increase in our knowledge of a group of difficult and confusing clinical entities.

In this book will be found clear descriptions of all of the affections in which the peripheral vessels of the limbs are the seat of either organic or spasmodic abnormalities. The author expresses his views simply and very clearly, with the result that the reader gains a proportioned and reasoned

description of each clinical disorder which is easy to understand and, perhaps more important, to remember.

This is a book which is a fitting companion to the author's "Diseases of the Heart." J. H.-S.

MANUAL OF EMERGENCIES, MEDICAL, SURGICAL AND OBSTETRIC. By J. Snowman, M.D., M.R.C.P.Lond. London: John Bale, Sons and Danielsson, Ltd. 1936. Pp. ix + 399. Price 10s. 6d.

The third edition of this handbook has been brought up to date by a complete revision of its contents.

In this volume the busy man will find the essentials of both diagnosis and treatment for nearly every known emergency, surgical, medical or obstetric. As such, it is a very useful book of a handy size, which will easily fit into the medical handbag—a place where it will assuredly justify its author's labours. J. H.-S.

LEHRBUCH DER MILITARHYGIÈNE. By many Authors. Edited by Professor Dr. A. Waldmann and Professor Dr. W. Hoffmann. Berlin: Julius Springer. 1936. Pp. 759. Price RM. 45.

The purpose of this lengthy volume of 760 pages is to provide in a single volume a comprehensive reference or textbook for the use of Specialist Hygiene Officers of the German Army, Navy and Air Force and with this object in view the keynote is clarity and, one is perhaps somewhat surprised to note, brevity with avoidance of repetition and multifarious references.

The book includes practically every subject normal to a standard textbook of Hygiene that is capable of application to Service conditions in peace and war, and as such cannot fail to be of the greatest value to the officers concerned.

The subject matter of each chapter is dealt with in considerable detail, so that its purpose as a book of reference is admirably fulfilled and reflects the greatest credit on the various authors. It is perhaps a pity that illustrations have been cut down to a minimum.

In a book of this magnitude detailed criticism of subject matter is an impossibility within the scope of a review, and it is only possible to refer to a few points selected at random from this mine of information.

The chapter on Air, after discussing chemical warfare, contains a reference to the possibility of bacterial warfare. The ethics of such a form of warfare are criticized and the conclusion is reached that it would not only be impracticable but might have an unpleasant "boomerang" action. The German gas mask is described and illustrated.

The chapter on Clothing contains much interesting information and it is worthy of note that the old pattern long Service boot has been abandoned, and reference is made (with illustrations) not only to the ordinary short Service boot as used in our Army, but also to the long-shaped field

boot—in this case half-laced only, with broad three-buckle flap—which was issued to British mounted troops during the Great War.

The chapter on Nutrition is excellent, and it may be noted that emphasis is laid on the necessity for rendering food palatable by adequate flavouring.

It is gratifying to find a reference to the fact that the British Barrack Commission following the Crimean War resulted in recommendations which served as a model for all improved barrack design and construction. The diagrams of modern barrack lay-out show general agreement in principle with our own.

As regards the employment of Psychological Tests (presumably what we refer to as Intelligence Tests) in the German Army, it is to be noted that even before the Great War attention had already been focussed on the possibility of their employment in the differentiation of those employed in military life. There is a reference to the American organization in this direction, and since the War this method has been greatly developed. It is of great interest to note that it was found inapplicable without modification to the small post-war German Army, but since then, as the result of much research work, it is being employed with the object of differentiating (*a*) the potential officers, and (*b*) those specially suited for the more highly technical or specialized forms of employment, e.g. wireless operators, pioneers, signals, armoured cars, artillery, mountain warfare, and flying.

Diseases of special importance to military life at home and under tropical conditions are dealt with at considerable length.

It will be seen that this is a highly comprehensive and valuable textbook upon which the authors are to be congratulated. A translation or a more detailed résumé could hardly fail to prove a mine of information for all who are interested in military hygiene.

Notices.

"RYZAMIN-B" RICE POLISHINGS CONCENTRATE.

"Ryzamin-B" consists of the concentrated and purified vitamin-containing fraction of rice polishings (recognized as a rich source of Vitamin B), and is stated to have a potency of not less than 50 International Units of Vitamin B_1 per gramme. Thus it is possible to add to the diet an adequate supply of the anti-neuritic factor in a relatively small bulk. Doses of Vitamin B, which could not be tolerated by many patients in the form of yeast concentrate, may thus be given with safety.

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a valuable prophylactic against polyneuritis. Further, it is stated to be necessary for normal reproduction and lactation.

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To supplement the diet in partial deficiences, a daily dose of 0·4 gramme of the concentrate is suggested. In the case of infants and young children, 0·1 gramme or more, according to age, may be given daily. It may be dissolved and mixed in the baby's feedings, if so desired.

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SCUROFORM.

THIS anæsthetic lozenge, manufactured by Messrs. May and Baker, contains two milligrammes butoform, with a carbohydrate base flavoured with vanillin.

It is stated to have local anæsthetic properties and to give rapid relief in all painful conditions of the mouth and throat, such as erosions of the buccal mucous membranes, tonsillitis, inflammation of the tongue, and sore gums that follow dental extractions. Throat irritation causing reflex cough is often successfully treated, and public speakers, smokers and others who suffer from pharyngitis appreciate the palliative effect of the lozenges.

One or two lozenges should be allowed to dissolve slowly in the mouth, followed by another when the effect of the first has passed off. No harmful effect is to be expected from the use of considerable quantities of these lozenges.

PLANACRINE ANTISEPTIC LOZENGES.

THESE lozenges are manufactured by Messrs. May and Baker and contain a mixture of 2:8-diamino-10-methyl-acridinium chloride and diamino-acridine, flavoured with glycyrrhizin.

They are stated to possess powerful bactericidal properties and to be free from irritating effects on mucous membranes.

They are adapted for disinfection of the mouth and throat, and for treatment of ulcerative conditions in these regions. Specially indicated in stomatitis. In simple sore throat, tonsillitis, nasopharyngitis, gingivitis and stomatitis, they combat the infection and relieve pain without an analgesic.

The lozenges should be allowed to dissolve in the mouth, they should not be chewed. Two can be taken per hour.

They are issued in pocket tins of forty lozenges.

THE BENJAMIN WARD RICHARDSON LECTURE.

Lieutenant-Colonel Gerald Leighton, O.B.E., M.D., D.Sc., F.R.S.E., will deliver the Benjamin Ward Richardson Lecture at the Royal Sanitary Institute, 90, Buckingham Palace Road, London, S.W.1, on Tuesday, November 10, 1936, at 5.30 p.m. The subject of the Lecture will be: "The Supervision of the Nation's Food Supply."

Sir William J. Collins, K.C.V.O., D.L., J.P., M.D., M.S., Vice-President of the Institute, will preside.

CHADWICK PUBLIC LECTURES.

Date and Time	Place	Lecturer	Subject	Chairman
1936. November. Thursday, 5th, 8.15 p.m.	London. Lecture Hall, Royal Society of Arts, John Street, Adelphi, W.C.2.	Robert R. Hyde, Esq., M.V.O., Director of the Industrial Welfare Society.	Malcolm Morris Memorial: Industry's Contribution to Public Health: Firms' Voluntary Medical Services	The Lord Trent
Friday, 20th, 8 p.m.	Gateshead. The Town Hall.	Lionel G. Pearson, Esq., F.R.I.B.A.	Modern Hospital Construction	His Worship the Mayor of Gateshead
Tuesday, 24th, 5.15 p.m.	London. The Great Hall, British Medical Association, Tavistock Square, W.C.1.	Sir Francis Fremantle. O.B.E., M.D., M.Ch., F.R.C.P., F.R.C.S., D.P.H., D.L., M.P.	The Doctor's Mandate in Parliament	Sir James Crichton-Browne, M.D., F.R.S., Chadwick Trustee
December. Wednesday, 9th, 8.15 p.m.	Manson House, 26, Portland Place, W.1.	Sir Weldon Dalrymple-Champneys, Bt., M.D., M.R.C.P.	Modern Views on Infection and Disinfection	Sir George W. Humphreys, K.B.E., M.Inst.C.E., Chadwick Trustee

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

Correspondence on matters of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a nom-de-plume.

All Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts in the case of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Reprints or excerpts, additional to the above, can be furnished on payment if specially ordered at the time of submission of the article for publication.

Communications in regard to editorial business should be addressed—"The Editor, Journal of the Royal Army Medical Corps, War Office, Whitehall, London, S.W. 1."

MANAGER'S NOTICES.

The Annual Subscription for the Journal of the Royal Army Medical Corps is £1 payable in advance. Single copies, 2s. 6d. per copy.

Cheques, etc., should be made payable to the "Journal R.A.M.C.," and crossed "Holt & Co."

Each subscriber who pays his subscription direct to the Manager will also receive monthly a copy of "The R.A.M.C., The A.D. Corps, and Q.A.I.M.N.S. *News and Gazette.*"

Communications in regard to subscriptions, change of address, etc., should be addressed "The Manager, Journal of the Royal Army Medical Corps, A.M.D.2, War Office, Whitehall, London, S.W. 1."

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Journal of the Royal Army Medical Corps

ISSUED MONTHLY

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MANAGER.
MAJOR W. J. F. CRAIG, R.A.M.C.

CONTENTS.

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VOL. LXVII DECEMBER, 1936. No. 6.

Journal

of the

Royal Army Medical Corps.

Original Communications.

THE DIAGNOSIS OF ACUTE APPENDICITIS IN THE ARMY.

By LIEUTENANT-COLONEL C. M. FINNY, O.B.E.
Royal Army Medical Corps.

IF one wishes to observe diseases in an advanced condition, it is advisable to go to some of the large civil hospitals, preferably in India, where the native population frequently avoid medical treatment until they are almost moribund.

The reverse is seen in military hospitals. Here may be seen the beginnings of diseases.

The civilian who feels out of sorts can possibly take things easily and put off visiting a doctor. The soldier leads a strenuous life and has to do his duty or report sick; consequently he is seen early, and, unless the disease is trivial, soon finds himself in hospital.

It is thus that in military practice patients are generally suffering from a few mild symptoms rather than textbook examples of well-established diseases.

We often see the man with renal pain and hæmaturia, but in only a small proportion is a calculus revealed by X-rays. Symptoms of early gastric and duodenal ulcer are common; but how often can even an expert radiologist show us an ulcer crater? Pain is common over the gall-bladder; but we do not often see signs of gall-stones in a cholecystogram.

It is not the fault of the radiologist. The reason is that the diseases have not progressed sufficiently far for gross changes in the organs to have developed.

I do not suggest that we never get examples of established diseases in military hospitals; but, compared with civil hospitals, we get a much higher proportion of early and mild cases, which are often very difficult to diagnose.

Appendicitis is no exception to this rule. We certainly get the obvious and fulminating cases, but we get more of the early ones and complications are less common.

A summary was published not long ago compiled from a large number of cases operated upon in the London and St. Thomas's hospitals. The total mortality was 7·1 per cent.

Compared with this, the mortality from acute and subacute appendicitis shown in the Annual Report on the Health of the Army, 1934, was 1·4 per cent.

This is a striking difference which obviously cannot be due to lack of skill on the part of the surgeons in the hospitals mentioned. It is due to the fact that at the time of operation complications had already set in. In only 35 per cent of these cases was the inflammation confined to the appendix, and a 25 per cent mortality from general peritonitis helped to swell the death roll.

The annual report for the Army does not give information as to the number of complicated cases dealt with, but I have kept notes of 300 cases upon which I have operated in various military hospitals. The number, though not great, is probably large enough to be representative of surgery in the Army.

In 75 per cent of my series the appendix alone was inflamed, and there were five deaths—a mortality of 1·7 per cent. Of these, one died from pulmonary embolus and one from ether convulsions. The remainder were late cases with peritonitis.

There is, thus, as mentioned before, a difference between the typical case of appendicitis met with in civil and military hospitals, so that I feel no apology is needed in giving some account of the disease as met with in the Army.

The difference between our cases and those seen in civil hospitals is due mainly to two factors. Our patients are as a rule otherwise healthy young adults and we see them earlier. The civilian's delay in reaching a surgeon may be his own fault—he does not call in a doctor in time—or it may be the fault of the general practitioner who does not appreciate the significance of the early symptoms—there is no rise of temperature and no rigidity, so all is well.

But often all is not well, and a protracted convalescence with a suppurating wound is not the least price paid for a tardy diagnosis.

Textbooks in the past have not been a help in this respect.

To quote a description of appendicitis from an excellent standard work: "The pain is rapidly followed by nausea and vomiting, and this is very soon succeeded by a rise of temperature, occasionally with an initial

rigor, accompanied by the usual constitutional symptoms of toxic fever. . . . Examination shortly after the onset shows the abdomen to be rigid, motionless, and uniformly tender: these signs usually become localized to the right iliac region."

This is a description of an early case, and yet there is already toxic fever with constitutional symptoms and the abdomen is rigid and motionless.

This type of case, of course, occurs, but it is the exception to find such definite physical signs except when the inflammation has already involved the peritoneum, and the symptoms are then those of early peritonitis.

The following case is much more typical of the cases admitted to Military Hospitals :—

Case 1.—Pte. C. was awakened at 2 a.m. by a severe colicky pain in the centre of the abdomen. He went to the latrine where his bowels acted, and he vomited without any relief.

Later the pain settled in the right iliac fossa and became more constant. When seen at 9 a.m. there was muscular resistance in this region and definite deep tenderness at McBurney's point. The skin of the right groin was hyperæsthetic and extension of the right thigh increased his pain.

Tongue almost clear, temperature 98·6° F., pulse 80, leucocytes 11,000 per cubic millimetre.

Operation 10 a.m.: The appendix was found sharply angulated. Beyond this point there was a large concretion and the mucous membrane was acutely inflamed.

A typical example of the acute obstructive type of appendicitis which no one could fail to diagnose. But unfortunately it is not always as straightforward as that. Compare the following :—

Case 2.—While at a dance Lance-Corporal P. was seized with severe epigastric pain and vomited. He drove back to barracks in a bus, and, as the pain got worse, he spent the night in a Detention Hospital. He was admitted to the Military Hospital next day. The pain had shifted to the right iliac fossa and was continuous.

Deep tenderness was most marked just internal to McBurney's point. Both recti were on guard, chiefly the right. There was definite superficial hyperæsthesia just internal to the anterior superior iliac spine, and extensions of the thigh caused pain.

His tongue was slightly furred. Temperature 99·2° F., pulse 78.

Operation : A perforated duodenal ulcer was found.

Case 3.—Major F. was awakened at 3 a.m. by a severe epigastric pain. This passed off by breakfast time. He did not vomit, but ate his meals and carried on with his duty. At 5 p.m. the pain returned but in the right side of the abdomen.

The next day the pain was better, but as it had not gone he drove himself five miles to see me just before lunch.

His tongue showed a white fur, and there was tenderness with resistance

in the right iliac fossa. No superficial hyperæsthesia, but pain on extending the thigh.

Temperature 99·2° F., pulse 84.

Operation 2 p.m.: A gangrenous perforated appendix as thick as a forefinger was removed.

Case 4.—Private C. felt cold one night in camp. This was followed by pain in the right side of the abdomen. He did not vomit but lost his appetite.

When admitted to hospital two days later the pain was worse, constant but stabbing at times. The lower right rectus was tender but not rigid. There was superficial hyperæsthesia along Poupart's ligament, pain on extending the thigh and on micturition, and tenderness on rectal examination. His tongue was thickly coated, and his temperature 98·8° F., pulse 70.

Operation revealed no obvious pathological condition, but a blood culture later showed that he was suffering from enteric fever.

These cases are not exceptional. They are given to show that diagnosis is not always easy. In a difficult case a correct solution of the problem requires a consideration of all physical signs and symptoms together with the history. One must not be put off by the absence of some particular sign, e.g. rise of temperature, or muscular resistance. If one knows which symptoms and signs are most commonly present, one is in a better position to assess their relative value.

I have so often seen my non-surgical colleagues surprised at the removal of a diseased appendix in a case where several textbook symptoms were lacking that I feel it may be a help to them to record the relative frequency of the main symptoms and signs of appendicitis as they occurred in my cases. The order of frequency was as follows :—

Local deep tenderness present in	98 per cent of cases
Pain the first symptom present in	94 ,, ,, ,,
Furred tongue present in	89 ,, ,, ,,
Vomiting or nausea present in	73 ,, ,, ,,
Pain on extending the right thigh present in	65 ,, ,, ,,
Pain starting in the middle line present in ..	60 ,, ,, ,,
Muscular resistance present in	55 ,, ,, ,,
Rise of temperature present in	53 ,, ,, ,,
Superficial hyperæsthesia present in ..	35 ,, ,, ,,
Increased pulse rate present in	33 ,, ,, ,,

It will be seen from the above that in many cases the textbook symptoms will be sought for in vain. Not one was invariably present.

Vomiting and nausea were absent in 27 per cent of the cases, the temperature rose above 98·6° F. in only 53 per cent, and in only 43 per cent of those seen during the first two days of the attack.

Real muscular rigidity was rarely met with except in cases with peritonitis; and increased muscular tone was observed in only 55 per cent. In the remaining 45 per cent the muscles were normal and on several

occasions so lax that the inflamed appendix could be palpated through the abdominal wall.

The pulse, another physical sign on which stress used to be laid, also fails us. It was increased to over eighty beats per minute in only 33 per cent of the cases.

I do not dispute that in a late case which is being treated on conservative lines, a rising pulse-rate is an indication that all is not going well, but an hourly pulse chart is a time-consuming substitute for more direct methods of diagnosis, and may be misleading in both directions.

In five of the gangrenous appendices I have removed the pulse was normal. On the other hand, a case was sent to hospital a few weeks ago with a carefully kept chart showing a steady rise of temperature and pulse. Other symptoms negatived a serious condition and at operation a mildly inflamed constipated appendix was removed.

My experience of the value of a white cell count is small and not encouraging. It is quite possible for a dangerously obstructed appendix to cause no leucocytosis. On the other hand, I was once encouraged to operate immediately on a patient with a leucocyte count of 22,600. The appendix was found adherent at its tip, but inflammation was slight and confined to the mucous membrane.

The above remarks have been made to show that one cannot diagnose appendicitis early if one waits for textbook symptoms. It is rather negative criticism, and possibly savours of "beating a dead horse." Let me therefore give the points which I believe will help towards early diagnosis.

First—and very important—is the history.

Pain is almost always the first symptom. In only 19 out of 300 cases was there a history of other symptoms preceding the pain, and strange to relate 17 of these were serious cases.

The pain usually, but by no means always, *begins* centrally, most frequently in the epigastrium. This pain is of course referred. On several occasions when operating under spinal anæsthesia, as I pulled upon the appendix the patient complained of the same epigastric pain as that which initiated the attack.

The pain, particularly at first, may be colicky in nature, but differs from an ordinary colic in that it is not relieved by vomiting or action of the bowels and it is unusual to have complete relief between the spasms. The patient often says that the pain gets worse at times but never leaves him. This *persistence* of the pain is a very valuable aid.

The pain may start at any hour, day or night. In my series only 30 per cent began between 10 p.m. and 6 a.m.; but I always feel that a pain which wakes the patient from sleep is likely to be due to appendicitis.

Perhaps the most important feature about the pain is that sooner or later it nearly always moves to the right iliac fossa and ceases to be colicky. The severity of the pain is of little help. It is as a rule worse when the serous coat is inflamed, but a gangrenous appendix tucked behind the

cæcum or wrapped snugly in omentum may cause little discomfort. Sometimes pain is only experienced on movement.

The pain is usually followed by vomiting (60 per cent) or nausea (13 per cent), and even if neither be present the patient loses interest in his food. The bowels may act but without relief. One often hears—"I went to the latrine and was sick there . . . Yes, my bowels acted, but I felt no better."

There is one other point in the history and that is the question of previous attacks. This does not seem to bear any relation to the type of symptoms except that when there is a history of frequently repeated mild attacks, a "constipated" appendix is often found.

So much for the history, which in itself may provide the diagnosis.

If a patient is awakened in the night by epigastric pain which persists and is followed by vomiting without diarrhœa, and later the pain tends to spread to the right iliac fossa—this history, coupled with local deep tenderness, is all that is necessary to make a positive diagnosis. But the history is not always so obliging, and a thorough examination of the patient becomes necessary.

Physical Signs.—The tongue is usually coated, but not heavily; in 54 per cent it was noted as a "slight white fur," and in 11 per cent it was quite clean.

Little help here, particularly as a furred tongue is common in the various conditions from which appendicitis has to be diagnosed.

But next we come to the most constant of all signs—local tenderness. This was present in 98 per cent of my cases, and with very few exceptions it was in the right iliac fossa at or near McBurney's point—in some it was beneath the right rectus.

It is the chief diagnostic sign to eliminate intestinal colic, which is usually relieved by pressure. It is undoubtedly due to tenderness in the appendix itself. I have had six cases in which a free appendix was easily palpable through the abdominal wall, and pain was only felt when it was pressed up.

Of the five cases in which this very important sign was absent, in four the appendix lay in the pelvis, and three of these were gangrenous—doubtless due to delay in diagnosis.

In these difficult pelvic cases help may be given by four symptoms—pain on micturition, pain on internal rotation of the flexed thigh, tenderness per rectum, and pain on extending the thigh.

I have not often found the first two of these of much value, but a rectal examination is undoubtedly of use. It is not so always. In two of the above cases the appendix, though pelvic, was too short to be reached and the surrounding tissues were not tender.

The thigh extension test is often very helpful. It may be observed in two forms. In one, the patient is unable to stand erect, and, if in bed, prefers to keep the thigh flexed. In the other the patient can lie flat, but if placed on his left side and the right thigh extended at the hip, he complains of pain in the right iliac fossa.

This test, while of value in the pelvic type, is useful whenever an inflamed appendix lies close to the psoas muscle. It was positive in 130 out of 200 cases in which it was employed. In only 39 per cent of the positive cases was the appendix free, so that it is more often present in the very cases which are not obvious.

Muscular resistance is tested for at the same time as deep tenderness, but is not so often present. It only amounted to definite rigidity in 26 per cent of my cases, and was absent in thirteen of those which had gone on to gangrene. It was, however, present in three of the cases showing no tenderness, and is undoubtedly a useful sign when present.

I have not found superficial hyperæsthesia of much value. It was present in only 37 per cent of cases, and was more common in the milder ones. It is also sometimes present in other diseases (*vide* Case 4).

I believe the above signs and symptoms provide sufficient data upon which the diagnosis may be made. After that it is no harm to consult the pulse and temperature as long as one's opinion is not shaken by finding both normal. Personally I feel more confident if they are slightly increased, but an early sharp rise of temperature makes me consider alternative diagnosis more thoroughly.

When I started keeping notes on appendicitis it was mainly with the object of trying to learn if the nature and degree of inflammation could be estimated before the abdomen was opened. It is obviously an advantage to know if the case is urgent or whether a delay of a few hours will do no harm; where it is best to incise the abdomen, and if a muscle-splitting incision will give enough exposure.

With regard to the question of where it is best to make the abdominal incision, there can be no doubt that, except when peritonitis has developed, the situation of deep tenderness gives a very good idea of the position of the appendix. Where this deep tenderness was definitely localized to one point, there the appendix was almost invariably found.

With a view to seeing if any particular group of symptoms could be correlated with any particular type of the disease I classified the various appendices found at operation into four types—gangrenous, obstructed, inflamed and constipated. They occurred in the following proportions :—

Gangrenous	40
Obstructed	111
Inflamed	88
Constipated	51

The meaning of the first two types is obvious. The others need some explanation.

I have used the term "inflamed" to mean an appendix in which all the coats are inflamed but not to the extent of gangrene, and in which there is no evidence of primary obstruction of its lumen.

I called "constipated" those appendices which were more or less full of semi-solid bowel contents, and only the mucous membrane was inflamed. This is the mildest type and obviously is least in need of surgical treatment. If the organ can be emptied with the aid of an enema the attack is soon at an end.

If, however, the mucous membrane near the base swells sufficiently to block the lumen, it becomes an obstructed appendix in which gangrene and perforation are only a matter of time.

I have tabulated the various signs and symptoms of appendicitis noted under the above four headings and these are shown in an appendix.

Complete records were not kept of every case.

I hoped by this means to be able to find some symptom or absence of symptom which was characteristic of each type. For instance, to be able to say—"This patient has no rise of temperature: his appendix is constipated and not urgent"—*or*—"This one has a rapid pulse-rate and rigidity: prepare him at once for operation"—*or*—"There is no superficial hyperæsthesia or vomiting: it cannot be a case of appendicular obstruction."

But apart from a few minor points, the only deduction of importance to be drawn from this analysis is that there is no one symptom which is either always present or always absent in any particular type of the disease. Some of the gangrenous cases showed no rigidity or fever; vomiting and superficial hyperæsthesia were negative in some of the obstructed ones.

It all tends to show that statistics are of subordinate help in matters of diagnosis.

Some people like to employ tables and calculations to enable them to declare their hands when playing Contract Bridge. In the same way they like "systems" in making a diagnosis and tend to rely on the laboratory and radiologist.

But, unfortunately for them, surgery is more of an art than a science. Statistics may help, but diagnosis must depend on a collection of data and a deduction from the positive signs and symptoms present—a real "appreciation of the situation."

Incidentally I feel that playing Bridge should be a good training for surgery. In both one has not only to make up one's mind unaided, but to act upon it; and the results of one's errors are felt not only by ourselves but by partners or patients.

There is still a difference of opinion among surgeons as to whether immediate operation or watchful delay should be the treatment when symptoms of appendicitis have been present for more than forty-eight hours.

I do not propose to join the controversy which has been argued on both sides by pens much more able than mine. But I do urge that if a positive diagnosis is made within thirty-six hours of the onset, it is always wiser to

operate, even if the case appears to be a mild one. This view has been more or less forced upon me by experience. Like a certain very distinguished surgeon, I am a physician at heart.

At one time I had a run of so many mild cases that I tried treating them by medical means—rest, starvation, enemata. But it did not work. Their symptoms rapidly subsided, but soon returned when they began to get up and resume a normal diet. They nearly all had to visit the operating theatre in the end, and got a poor return for their starvation and increased length of occupation of a hospital bed.

But of course the real reason for advising operation while the appendix alone is inflamed is that under such circumstances it is a very safe and usually easy one—whereas the patient's life is definitely in peril once the inflammation has spread beyond the confines of the organ. The more I see of the disease, the more I am convinced that it is impossible to forecast when this will occur. The mild, constipated appendix may become obstructed and perforate in a few hours; or more often mild symptoms may mask a dangerous condition.

I feel I cannot point this moral better than by a comparison of two final cases.

Case 5.—Fusilier W. was seized with fairly severe general abdominal pain at 10 p.m. and vomited. When seen at 1 p.m. the following day the pain was chiefly in the hypochondrium with tenderness and guarding of the lower right rectus.

He was constipated, with a furred tongue, and extension of the right thigh was painful. Temperature 100° F, pulse 90. Leucocytes 22,600 per cubic millimetre, with 85 per cent polymorphs.

Case 6.—Driver C. felt a pain in his epigastrium at 2 p.m. He did not vomit but lost interest in his food. The pain did not keep him awake that night, but as it was still present the following morning in spite of a natural action of the bowels, he reported sick. When seen at 11.30 a.m. there was a mild but constant pain in the hypogastrium tending to spread to the right iliac fossa. His tongue showed a thin white fur, and deep pressure over McBurney's point caused pain, though there was no muscular resistance. There was no superficial hyperæsthesia, and other signs were absent. Temperature 97° F., pulse 76.

Both patients were operated upon an hour after being seen.

In the first case the appendix was found adherent throughout, but there was only slight inflammation, which was confined to the mucous membrane.

In the second the peritoneal coat was already inflamed. The appendix was obstructed near its centre. Beyond this it was tense with pus, and the mucous membrane already gangrenous.

Further comment seems superfluous.

APPENDIX.

The following tables give a résumé of the various signs and symptoms found in my series of cases. Complete records were not kept in every case, so that the totals do not in every case come to 300.

TABLE 1.

This shows the incidence of vomiting, temperature, and superficial hyperæsthesia.

	Vomiting	Nausea	Neither vomiting nor nausea	Total	Temperature		Superficial hyperæsthesia	
					Raised	Normal	Present	Absent
Constipated ..	28 50%	6 9%	23 41%	57	24	33	26	26
Obstructed ..	68 61%	15 14%	28 25%	111	47	56	39	59
Inflamed ..	55 60%	17 19%	19 21%	91	45	38	32	54
Gangrenous ..	29 70%	—	12 30%	41	31	4	4	29
Totals ..	180 60%	38 13%	82 27%	300	147 53%	131 47%	101 38%	168 62%

Vomiting and nausea were absent in 41 per cent of the constipated cases, but in only 24 per cent of the other cases. Absence of vomiting favours a mild case.

It is noteworthy that this symptom was not found more often in the obstructed cases than in inflamed or gangrenous.

Superficial hyperæsthesia was present in 101 cases out of 269, but was least common in the gangrenous cases. This agrees with the generally accepted view that it is caused by tension and it is not present as a rule once the appendix has ruptured. If present, this symptom suggests an uncomplicated case.

The temperature was above normal in just over half the cases.

Table II was prepared to show the effect of duration of the disease on the temperature compiled from records of 200 cases.

TABLE II.

Period since onset of attack:	Less than 24 hours		More than 24 hours		Total	
Temperature ..	Raised	Normal	Raised	Normal	Raised	Normal
Constipated	6	6	10	17	16	23
Obstructed	14	24	22	23	36	47
Inflamed	8	11	23	12	31	23
Gangrenous.. ..	3	—	18	3	21	3
Total	31 43%	41 57%	73 57%	55 43%	104	96

As might be expected, fever is more frequent in the late than in the early cases.

It may be noted that in the first two types the temperature was more often normal than raised; but that absence of pyrexia was exceptional once gangrene —with consequent peritonitis—had set in.

TABLE III.—SITE OF PAIN AT ONSET.

	Right abdomen	Central	Left abdomen
Constipated	22	14	–
Obstructed	28	56	1
Inflamed..	23	32	–
Gangrenous	4	18	2
Total	77	120	3

This supports the generally accepted view that the pain of appendicitis typically *starts* in the middle line. Only in the constipated cases did it more frequently begin in the right side of the abdomen.

As this central onset of pain is liable to make the unwary think that the attack is a simple attack of colic, which only needs a dose of castor oil, I analysed the type of pain in 200 cases.

This is shown in Table IV.

TABLE IV.—TYPE OF PAIN.

	Constant	Colicky	Total
Constipated	50	5	55
Obstructed	51	20	71
Inflamed	47	6	53
Gangrenous	20	1	21
Total	168	32	200

In only 16 per cent was the pain of a colicky type when the patient arrived in hospital. This type of pain is most common when the appendix is obstructed. It occurred in nearly 30 per cent of these cases.

Stress is often laid on muscular rigidity as an almost essential sign of appendicitis. This was investigated in 260 cases, with the following unexpected result:—

TABLE V.

	1. Muscular resistance	2. Rigidity	Total 1 and 2	Muscles normal	Total cases
Constipated	12	8	20	26	46
Obstructed	33	20	53	41	94
Inflamed	18	22	40	38	78
Gangrenous	11	18	29	13	42
Totals	74	68	142	118	260

In 45 per cent of cases, including thirteen of the gangrenous ones, the abdominal muscles were normal. What is perhaps more remarkable is that definite rigidity was found in eight of the mild constipated cases in which there was no question of peritoneal inflammation.

It may possibly be accounted for by the fact that a nervous young man, particularly on a cold day, sometimes finds it impossible to relax his abdominal muscles.

REFERENCE.

ADAMS. *Brit. Med. Journ.*, April 18, 1925.

PLAGUE IN SECUNDERABAD, 1934-1935.

By Major A. E. CAMPBELL,
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I.—Introduction.

Plague broke out amongst the civilian population of Secunderabad Cantonment in August, 1934, and continued until March, 1935. No cases occurred in the military lines.

Personal introduction to the locality and to the disease in an epidemic form were simultaneous and as a result first impressions were considerably enhanced. In attempting to complete the inevitable report some difficulty was experienced in separating these impressions from events which required record. The report completed, time became available for the study of existing preventive measures, and early experiences again returned to be assessed and disposed of.

The subsequent reorganization has now been completed in many respects and has undergone some initial trials. At the time of writing early contact is likely to be made with a practical test in the form of another epidemic.

The sections which follow are an attempt to describe a series of experiences and do not deal with every aspect of the disease. Particulars of the epidemic are given to serve as a background to the consideration of a number of practical difficulties which occupied much time and were detrimental to the simultaneous study of underlying causes.

II.—Local Considerations.

The Cantonment of Secunderabad is situated to the North of the city of Hyderabad, the capital of H.E.H. the Nizam's Dominions, and joined to it by a suburban area through which much traffic of all kinds takes place. Some thirty villages are scattered close to the remainder of the boundary and with these also there is much intercommunication.

Shaped like a J with a bulbous enlargement of the hook, it covers an area of 21 square miles, measures at its greatest length 8 miles, at its greatest width 4 miles and is inhabited by 130,000 persons distributed in a manner which is of much importance. Roughly 60 per cent are housed in Secunderabad "Town" in the trough of the J, the remainder being scattered in some thirty villages or bazaars of anything from fifty to five hundred houses.

Military lines and bungalows seem to have been sited in intervening open spaces which in some cases are occupied by cultivators living an arcadian and independent existence around their wells.

Housing conditions are generally unsatisfactory though a number of

clearing and reconstruction schemes are being carried through with excellent results.

Overcrowding is widespread and there is much congestion of buildings both in "Town" and villages.

Residents are of all classes, but many are poor casual labourers and much coming to and going from work occurs every day.

Of climatic conditions it need only be said that previous epidemics have commenced between August and November and that the onset of warmer weather in March has brought them to a close.

Twelve epidemics have occurred since 1911.

The city of Hyderabad and, to a less extent, the surrounding villages are served by a Special Plague Department under State administration, which is highly organized and most efficient.

The general impression it is desired to give is of a large area under a single civil administration, subject to recurring epidemics of plague, situated in one similarly affected, containing in itself a large congested area and many scattered villages between which elements much movement takes place and withal a Cantonment housing a military population of 12,000 persons including troops, families and followers.

III.—Origin of the Epidemic.

In the latter half of August, 1934, suspicions were directed to an area in the Town by reports of the removal of a case of plague. Inquiries unfortunately proved abortive and evidence of rat infection did not come to light immediately. There was a lack of information, but inquiries were pursued and preparations made.

When inspecting an outlying area used in former years as a plague camp, some hutting materials were noticed. The owner was traced to his home in the suspected area some three hours later and a number of dead and infected rats were found.

There was little anxiety noticeable amongst local residents. The danger was consciously disregarded or not generally known.

Human cases occurred in nearby houses on August 25 and continued to occur in the same locality until November 14.

Infection was well established when discovered, and information subsequently and carefully collected regarding the rat population has shown the area to be one of great potential danger.

IV.—Dissemination of the Disease.

It is difficult and somewhat depressing to attempt to describe the spread of the epidemic.

In regard to the epizootic, public co-operation was lacking and rat falls were not reported. As the epidemic spread and alarm and subsequent movement increased, routine trapping measures and the obtaining of

information concerning the rat population became much more difficult and often impossible. The reasons for this may become more obvious when the circumstances of evacuation of houses and the establishment of camps are considered.

In the "Town" area and taking 60 small sub-divisions, the spread was to 3 in August, 17 in September, 18 in October, 12 in November, 8 in December and 2 in January.

The appearance of infection in the outlying villages was more easily observed.

On August 31 a case brought from the "Town" was discovered in a bazaar eight miles away and promptly removed to a hospital. All local precautions were taken and no cases appeared until November 15 when spread from a neighbouring bazaar was proved.

On September 15, infected rats were found near a grain store in a bazaar six miles away from the Town. Every effort was made to prevent human infection but twelve cases occurred in the ensuing month.

Within another week two other widely separated areas produced cases centring around grain shops in both instances.

Thereafter cases appeared in all outlying bazaars and villages, but in eight of these no spread of infection took place and local measures appeared effective.

Mention has been made of grain shops as possible foci of infection, but local experience, which is supported by that in Hyderabad, suggests the very great importance of human movement and the accompanying transport of fleas. The complexities of such movement amongst a large population in a wide area may be appreciated, and it is proposed to digress for a moment to accounts of the tracing of a few cases which may illustrate this and other points and also serve as a link with the next section.

* * * * *

Towards the end of an evening's inoculations a locked house was reached in a locality where infected rats had been found. The neighbours professed to know nothing but the circumstances were suspicious. Further questioning was useless and there was nothing to be done but to make an official departure and wait for information to be acquired indirectly. It arrived after half an hour and the story was that a woman suffering from fever had been taken earlier that day to a place about three miles distant.

The journey was a trying one driving in the half light along a track which, when it was not running along narrow ridges, dropped rather suddenly into dry water-courses. Walking the last few hundred yards the search party came on a bullock cart near an isolated house. There was no one about, but the cart was evidence enough and in a back room of the house were found the sick woman and her relatives. That she should have been suffering from plague was perhaps to be expected but that the bubo proved to be epitrochlear was a somewhat unnecessary early lesson in the diagnosis of the disease.

On the following day the report was received of the death in an outlying village of a woman who was known to have lived in the area already referred to. Having no right to enter the village for purposes of inspection a visit was obviously unwelcome, but it was admitted that a death had occurred and requests to be allowed to see the body were eventually agreed to. Bending low to enter a tiny and very dark hut it was with difficulty that one could distinguish lying in a corner on some straw the fully clothed body of a woman. The relatives gathered in a group outside. Such examination as was possible under the circumstances revealed nothing of assistance. The stories told were conflicting even as to the length of the illness. There had been a death and it was an event, but not one which concerned strangers.

* * * * *

On one occasion a medical sub-registrar refused to issue a death certificate for a woman who had died from supposed pneumonia of very short duration. The circumstances which were revealed on inquiry were as follows. Although a relative of the household in which she had died, the patient had been brought some days before by her husband, a minor local official, from an infected village five miles away where one of her children had succumbed to an attack of bubonic plague.

Subsequent events were dramatic in their suddenness. The death of the woman occurred on a Thursday. On Saturday the husband reported that he and his family were all well. On Sunday he could not be found, but on Monday he reported to the local dispensary and was immediately sent for admission to the isolation hospital. On Tuesday the clinical picture presented was one to be remembered. The intense pulmonary involvement, "the copious, watery, sanguineous sputum teeming with plague bacilli," the hopeless fight of a man who knew his fate. He died early the following morning and no further cases occurred in his family.

In at least one general account of the disease mention has been made of the fact that frequently only one case occurs in a household. The series just described was repeated in almost identical and tragic circumstances a month or so later, and on another occasion the meeting of relatives in an infected house resulted in five attacks of which three were fatal, all being of the bubonic type.

* * * * *

In all the instances quoted there were elements of concealment and these, often combined with active opposition, were met in all efforts to trace cases, contacts and rat falls.

V.—Cases and Contacts.

There were 615 cases of undoubted indigenous infection and 69 believed to have been imported from surrounding and infected areas in the State. This importation or re-importation of infection increased still further the complexities of origin and spread in different localities.

The mortality for the whole epidemic was just under 80 per cent and was highest in the early stages when many diagnoses were of necessity made post-mortem. Visits paid to private houses for this purpose were enlightening experiences both in regard to the disease and the mental attitude of contacts.

* * * * *

Efforts to ensure the removal of patients to hospital were met not infrequently by opposition which, though appreciated in its origin, had none the less to be overcome.

The isolation hospital was conveniently situated to the most populated centres, but at a distance from outlying areas to whose inhabitants it appeared as a place from which there was no return. As far as plague was concerned there was unfortunately reason for this impression even though the hospital mortality was much lower than that for the whole epidemic. If compulsion to ensure removal to hospital was successful it was always followed by concessions. The number of persons accompanying the patient was not restricted unnecessarily and if so desired the family physician was allowed to carry on the treatment.

It was encouraging to find that the arrival of the motor ambulance and some persuasion were often sufficient and that cases were frequently brought to the hospital direct. Favourable influences were at work even in the face of fear, prejudice, and ignorance.

* * * * *

Cases treated in hospital numbered 282 amongst whom the mortality was 62 per cent.

Close contacts of a case removed to hospital were segregated there also in special contact sheds and disinfection and inoculation carried out.

If the case was the first in a locality, special efforts were made to secure inoculation of all persons and evacuation of all houses in the immediate vicinity. Houses were also disinfected and all rat-holes fumigated and closed, but as the epidemic and the amount of evacuation progressed such measures became proportionately limited.

VI.—Protection of the Healthy.

Mention has already been made of the absence of much public feeling in the area where rat falls were first discovered.

Speaking generally rat falls appeared to cause movement from the immediate vicinity and the occurrence of cases a more widespread exodus. Exceptions, however, were found in different localities and communities.

It was necessary to investigate the reasons for movement in any locality as possible indications of unknown sources of infection and to suspect the urgency expressed by the persons concerned as being proportionate to such reasons.

Movement from an infected area was controlled under a series of temporary regulations, and permission was necessary except to occupy sites

in a health camp in which case application for a hut or a plot of ground was sufficient. Attempts on the part of individuals to avoid complying with the regulations were inevitable and, being suspect as to their motives, gave rise to some personal and official irritation.

Preventive measures at this stage and in any locality consisted of action in and around sources of infection and efforts to control the rate and destination of movement. In both spheres theoretical considerations were sound. In practice it must be said that the second in its urgency greatly affected the first and was not always amenable to such considerations. Difficulties had to be experienced to be appreciated.

* * * * *

The practice of going out into camp was well established amongst certain classes and hutting materials were often to be seen stacked in back-yards and on the roofs of outhouses in preparation for what was almost a yearly migration. It was unfortunate that, like many good habits, it was by no means universal or reasonable. From a newcomer's point of view it was difficult to appreciate when and to what place movement would take place. Many people acted on official advice and took up camp sites allotted. Others refused to move but later disappeared from their homes. Some went far, others believed that sleeping in huts fifty yards away and using their houses only by day was sufficient. Some favoured places of religious importance, but no matter what was chosen custom appeared to be the strongest influence in making the choice.

* * * * *

Throughout the epidemic 25 camps of 6,768 huts housing 28,857 persons were established under the control of the Cantonment Authority. The Authority itself bore the cost of erection and maintenance of 2,345 huts for which matting and bamboos were provided. In other cases plots were marked out and individuals were allowed to erect their huts according to their own requirements within the limitations of such plots.

All camps were provided with a piped or controlled well water supply, dust-bins, latrines and lighting, and in the larger camps outdoor dispensaries, child welfare centres and schools.

* * * * *

The allotment of plots in camps produced many problems of the type which Solomon is said to have solved with great efficiency. Failing such judgments it was sometimes necessary to leave the solution to the urgency of the situation.

A camp was being established outside one village. The unfortunate sanitary overseer, who had received instructions in regard to the general lay-out, was found surrounded by a mob of women who obviously were not appreciating his efforts in allotting plots on which huts were to be erected.

Authority had to be upheld and the main public health consideration

appeared to be the leaving of an open space between the village and the camp.

Having cleared the crowd away the overseer was told to pace out the desired distance, turn his back on the village and spread out his arms. Instructions were then given that no huts were to be placed behind him. The results were startling and the scene must have been comparable to a gold rush, but out of pandemonium came some order and although the lines of huts were not always straight and one man's sullage water occasionally ran into another man's kitchen sufficient huts were up by nightfall.

By military standards the cleanliness of the camps left something to be desired, but it was noticeable that individual huts were often spotlessly clean, the sweepings having been thrown out on to public ground.

It was frequently necessary to combat criticism from those who know little of the conditions under which the people normally lived, and considering the facilities available and the numbers of children, the campers, with certain class exceptions, adapted themselves well to the open-air life.

* * * * *

The epidemic flared and spluttered and went out, some said for eighteen months, but a neatly rolled chart, when removed from its hiding place and unrolled, showed that a different sequence of events might again occur.

No matter what happened, there was to be a breathing space when attention could be turned to other problems and time given to the writing of a report. This, when produced as rather a bald statement, only served to show how much there was to be done and to be known.

The epidemic was over and the general public very naturally wished to forget about it. Plague was a doctor's business; perhaps it would be more correct to say a sanitary business as the disease was not a popular one clinically.

The responsibility, however, remained for preventive measures, and an attempt was made to review these in the light of recent experience.

The series of headings which was drawn up was by no means complete, but was sufficient to set a number of people to work collecting information, undergoing instruction, trying out new methods, and generally taking an intensive interest in a subject of very wide ramifications. Those headings now follow.

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A.—Rat Campaign.

(1) Division of the cantonment into areas under an overseer having in his charge a gang capable of carrying on all methods for the destruction of rats and fleas.

(2) The allotment to each coolie of a number of houses based on a cycle of two months' work of daily trapping and baiting.

(3) The supply of traps to provide each coolie with fifty, using a minimum of two in each house and dealing with an average of twenty houses on each of three consecutive days.

(4) The supply of barium carbonate and flour pills for issue to houses for three days prior to the setting of traps.

(5) Arrangements for the killing of trapped rats and the labelling of all dead rats.

(6) Arrangements for the safe transport of dead rats to the central laboratories for examination.

(7) The examination of rats—macroscopically and microscopically—for evidence of plague infection.

(8) The recording of results showing the species of rat, sex, and whether adult or young, and general particulars of all other rodents.

(9) The taking of a regular flea count.

(10) The use of fumigants on a three months' cycle and the recording of the number of holes closed and rodents killed.

(11) The substitution of the hydrogen cyanide class of fumigant for sulphur dioxide. Training in its use and necessary precautions.

(12) The institution of weekly and monthly returns giving particulars of all work carried out.

(13) The use of the results from trapping for the calculation of rodent and rat indices, i.e. the number of rodents or rats caught per hundred traps set.

B.—By-laws.

The preparation of a series of by-laws to provide for the carrying on of routine measures of rat destruction, the reporting of rat falls and human cases, restriction of movements from an infected locality, the importation or housing of cases, the compulsory evacuation of an infected area, and the re-occupation of an area declared free from infection.

Powers for the enforcement of these by-laws to be given to the officers of the Health Department.

C.—Case Investigation.

Instruction of all the staff of the Health Department in the necessity for the collection and circulation of information regarding new arrivals in their areas and sudden departure therefrom.

Co-ordination of the medical, sanitary and epidemic branches of the Department, the first being concerned with diagnosis, the last with preventive measures and the second with the general sanitary control of the area.

Methods for the collection of information and vital questions to be asked.

D.—Inoculation and Disinfection.

Arrangements for the inoculation of all personnel exposed to risk without interruption of routine work.

The preparation of inoculation kits for areas and the allotment of personnel for team work.

The preparation and supply of disinfectants—apparatus and personnel for their use.

E.—Health Camps.

The abolition of the expression "plague camp."

Rights to secure the rapid occupation of all land required.

The marking out of plots and utilization of all available ground.

The supply of hutting materials.

The allotment of plots and control of occupation.

The provision of the conservancy equipment, including latrines, pans, stands, receptacles, the necessary staff and arrangements for maintenance.

Rubbish collection and removal.

Drainage—such as could be improvised.

Water supply—the extension of an existing nearby pipe supply or the protection of well supply.

Lighting, fire and Police arrangements.

Provision for child welfare work and schools.

The provision of segregation huts for suspected contacts.

The collection of a suitable supervisory staff.

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It had been necessary at the commencement of the epidemic to advise an employer of labour to have his staff inoculated, and while agreeing to do so he had said that plague was an annual occurrence and that the usual precautions were taken. Six months later the subject of plague arose by chance in conversation and he inquired what action was being taken by the public health authority in regard to the prevention of the disease. The obvious reply was too easy and it was, and is, advisable to leave the answer until the passage of time supplies its own or the necessity arises for writing in just one more account of a spreading epidemic: "A case of plague occurred . . . and the usual precautions have been taken."

WHAT MEDICINE OWES TO WAR AND WAR OWES TO MEDICINE.[1]

BY MAJOR-GENERAL R. M. DOWNES, C.M.G., V.D.,
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PRESIDENTIAL addresses in this Branch have sometimes covered professional subjects of especial interest to the speaker, sometimes matters of import to the organization, economics or standing of the profession, sometimes a review of the happenings and tendencies of his year of office, and occasionally matters of history. It might have been thought that in such an epochal year of our Branch history a survey of what the recent annual meeting of the Association has meant to us and will do for us would be the most appropriate theme ; but I felt that a little more time would make the repercussions more definite, and, furthermore, that perhaps we have earned a slight respite from medical politics. So I thought the more readily to interest the stout few who always form the audience at these annual occasions by some story concerning the subject that now is my chief interest—the Medical Services of the Army and Air Force—and in the brief period that has been available to find such a story in this year of grace, I decided that it might be profitable to review the influence of war and medicine on each other.

As Sherman, and no doubt millions of others, said : "War is hell" ; nevertheless it is a biological necessity that has to be faced, and the history of the human race is largely written in war. What knowledge did our craft forefathers and what do we, the descendants of Æsculapius, owe to war, and what has the same army of healers done to make the waging of war more possible ?

First of all we should from its earliest known beginnings trace as carefully as possible the evolution of the great complicated machine which now serves the health of soldiers in the field, but time will not permit of doing this in detail. Let us, however, take notice of the growth of this machine from a feeble thing of few parts in which the personality, intellect and character of the individual was the dominant factor, to the complicated organization of mutually dependent workers that with much oiling by experience has become the more or less smoothly running engine —a modern army medical service. In the past names such as Theodoric, Paré, Larrey and McGrigor stand out in their periods as men to be wondered at ; yet the lot of their sick and wounded could not be compared

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[1] An address read at the Annual Meeting of the Victorian Branch of the British Medical Association on December 4, 1935. This article has appeared in the *Medical Journal of Australia* and is published here by permission of the editor of that Journal.

with that of their successors in the last Great War. The individuals responsible for this improvement, however, are so many and of such equal achievement that no single man could win that fame that permits his name to go down among the great in history.

As long as mankind has existed there has certainly been war; war means wounds and wounds mean people to treat them. The earliest evidence of treatment, going back almost to the first known writing in history, is found in one of the most fascinating and delightful documents any student of history could hope for, the Edwin Smith papyrus. Named after its discoverer, who obtained it at Luxor in Upper Egypt in 1862, it lay undeciphered until 1928, when it was published.[1] It is a copy by an unknown physician of the eighteenth dynasty in the seventeenth century B.C. of the surgical treatise of the Pyramid Age, written at least one thousand years earlier. There is some reason to conjecture that the author may have been the first known physician, Imhotep, a great personality of the third dynasty, about 3000 B.C., who after his death was deified and worshipped by the Greeks as Asklepios, by the Romans as Æsculapius, the God of Healing. He was high priest, vizier, architect and philosopher to the great King Zoser of that dynasty. From his description of cases, it is obvious that he followed the wars. His methods of treatment were founded on observation and thought, and are in sharp contrast to those of his unknown copyist of some 1,300 years later, whose principles of treatment appearing in the same document depend on incantations, charms, magic and weird medicaments. All of the fifty-eight cases described are dealt with in most orderly fashion—first the title, then the examination, followed by the diagnosis, treatment, and in some cases, a glossary of the meaning of terms that had gone out of use in the intervening years. The wounds and injuries are described in order from the head downwards, while in the different areas superficial and slight wounds precede those penetrating more deeply. It is interesting to note that surgical operations were considered only as part of the examination, nothing that did not include application of medicaments being dignified as treatment. In all cases a decision as to its possible cure is given in one of the formulæ "an ailment that I will treat," "an ailment with which I will contend," or "an ailment not to be treated." Imhotep knew something of cerebral localization to the opposite side of the brain, of the spine as a nervous centre, of the existence of a cardiac system and the pulse, and was very close to a knowledge of the circulation of the blood. He dissected, made use of his finger as a probe, describes what can be recognized as tetanus, and depended on Nature considerably for cure. Some of the methods, which make us wonder whether anything is new, will be mentioned as we go along.

We next learn of what corresponds to our present-day regimental

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[1] It is a sad coincidence that we read in the cablegrams of the death of the translator, the famous Egyptologist, Brensted.

medical officers in the Trojan War, about 1200 B.C. Again Hippocrates in the fifth century B.C. alludes to them several times, one being his son, Thessalus. The Romans, however, until much later, made no use of physicians in their armies, apart from those whom the commanders or other officers took into the field for their private use. Pliny says that they were none the worse off for the lack. It appears that about the first century B.C. they established a regular medical service consisting of both physicians and tents for the sick, the latter forming hospitals or valetudinaria, the ruins of one of which are found in a camp of the first century A.D. The first record of the forerunner of the modern field ambulance is in the Roman Army in the sixth century; after that they seem to have gone out of fashion for some centuries. While Henry of Navarre at the end of the sixteenth century established "portable hospitals" in addition to "fixed hospitals," the former being christened "ambulances," they do not appear in British history till the wars of William III and Mary, when they were called "marching and flying hospitals" and included springed ambulance wagons. They disappeared, however, after Marlborough's campaigns which ended in 1711 until the nineteenth century, when McGrigor persuaded Wellington, in the Peninsular War, to allow him to form regimental in addition to base hospitals. Napoleon's great surgeon, Larrey, had, however, reintroduced "flying ambulances" a few years earlier. His ambulance cadre, or division comprising a personnel of 340 and including 12 light and 4 heavy cars, was ahead of anything of the kind in any war, even including the South African, up to the Great War. In these the wounded after Eylau in 1807 were transported to châteaux more than fifty-five leagues distant. There was little advance in the English Army in the Crimea, nor till the South African War, when "bearer companies" and "field hospitals" came into being. The next step was in their amalgamation after this war into field ambulances, which have undergone considerable modification and additions both during and since the Great War (be it noted that a similar name was given a century earlier to the Napoleonic Wars) into units which provide for operative and medical treatment, as well as wheeled motor transport for the sick and wounded from the battlefield. The former fixed hospitals are now known as general hospitals, while an intermediate casualty clearing station has been introduced and convalescent depôts for the healed. The springless carts for the wounded have grown into motor ambulance convoys, hospital trains, hospital barges, hospital ships and aeroplane ambulances. These, with units for bacteriological and chemical examination, for the supply of every variety of medical and surgical equipment and the manufacture of splints, make up the modern army medical service.

Contrast the few lone physicians of earliest history with the mobilization, almost complete, of the whole medical profession of Great Britain, Germany and France, and the hundreds of thousands of rank and file of the last war.

My purpose is to review whatever knowledge in the art of healing and in prevention of disease has come from the long pageant of Army physicians. Since soldiers in the main are the pick of the community, young and healthy, and through their calling prone to injuries, it is natural that surgery is the branch of medicine that has most benefited, and traumatic surgery in particular. In fact nearly all early surgery was war surgery, and very little advance was made apart from war. In England at least, training in surgery was obtainable only in war until the middle of the eighteenth century, when civil hospitals became numerous. The charter of the Royal College of Surgeons of Ireland includes "for the purpose of training surgeons for His Majesty's Army."

It is not possible in this paper to survey in any detail the progress of military surgery, but it is noticeable how periods of enlightenment were followed by those of ignorance, and how often discoveries are rediscovered. One may cite Larrey, who practised excision of wounds, a practice now looked on as probably the greatest surgical advance of the last war. Then at the beginning of the nineteenth century ulcers of the leg were a great cause of invalidism in the Army till an Army surgeon, Baynton, began a method of strapping with adhesive plaster and bandaging, by which the disability was completely mastered. We are just re-discovering this.

The surgeon, who may have been Imhotep, nearly five thousand years ago used splints, not only of wood, but of plastered or glued linen; that has a modern sound. He padded wounds after suture with fresh flesh—no doubt to stop hæmorrhage—a method we re-learnt in the Great War, and I venture to say the use of which as a hæmostatic is known now to but a small proportion of our profession. He also treated a fractured clavicle by the most refined modern method of placing the patient on his back with a pad between the shoulders. As to wound treatment, the basis of all war surgery, the Greeks in the time of Hippocrates practised unknowingly much asepsis, boiling or filtering the water used to wash wounds, while the surgeon's hands and nails were kept clean and wine was used on wounds as well as poultices around, but not on, the wounds.

Prior to the sacking of Byzantium by the Saracens in 640, surgery as known to the Greeks and Romans was based on scientific reasoning. Thereafter it lapsed badly, and fatalism and magic replaced science for two hundred years, although the writings of the Greeks and Romans had been kept, until the renaissance of surgery in southern Italy, where the tradition of Greek medicine had not been entirely lost.

As late as the thirteenth century, however, when wounds were caused by arrow, sword, lance or dagger, treatment was in the nature of applications of salves, ointments, powders and decoctions, while suppuration was considered normal and necessary for proper healing; if there was none, medicaments were used to promote it in accordance with the teaching of Galen. The wars of this period produced a remarkable set of surgeons. Theodoric, an Italian, denied the "laudable pus" theory and returned to

dressings soaked in wine. William Salicet, another Italian, sewed up wounded large intestine "as furriers sew a skin," replacing it in the abdomen, and found that it healed. De Mondeville, the pupil, went further: he removed foreign bodies from the chest, closing the wound at once. De Chauliac in the next century returned to ointments and meddlesome surgery as by the injection of medicaments and the practice in the case of chest wounds of leaving them open; he threw wound treatment back, never to recover completely till the time of Lister, although Paracelsus, another Army surgeon, at the beginning of the sixteenth century was an aseptist.

With the discovery of gunpowder at the end of the thirteenth century wounds became much more unpleasant, and the inflammation that usually resulted was put down to the effect of the gunpowder. The recognized treatment in the hope of preventing it was cauterization with boiling oil. It is a well-known story how Paré, in 1531, running out of oil after his first battle, found to his great relief that the wounds not treated with oil did far better than the others. Hieronymus Braunschweig, in 1497, in the first known article on gunshot wounds, included in a book on war surgery, insisted repeatedly that wounds could not heal without cleanliness. He also held what is perhaps insufficiently realized nowadays, that firearm missiles may sometimes be left in situ without any harm. He had evidently, too, knowledge of human nature, for one of his methods of stopping bleeding was to put the patient in the dark so that he could not see the blood and tell him that it had stopped. Ambroise Paré, in the sixteenth century, was one of the greatest surgeons in history. He is usually credited with the invention of ligature of arteries, but incorrectly, as this procedure appears in the writings of Celsus in the first century A.D., while de Mondeville was also familiar with it. A man of great ability, Paré did more in the actual practice of surgery and in discarding the unpractical therein rather than in adding to it. In his time physicians were not allowed by the church to shed blood, consequently surgeons were looked on as of an inferior caste and formed an unorganized trade. By his efforts their standing was improved before his death. It would appear that he recognized flies as carriers of infectious diseases, and no one prior to him seems to have done so.

It is rather striking that in an age when such preponderating faith was placed in particular remedies, Paré should have realized what even now is so often forgotten, namely, that there are few diseases in which the physician brings about cure; he merely assists the natural processes of repair and resistance. This he showed by his oft-repeated conclusion to a case: "I dressed him and God healed him."

John Hunter, at the beginning of his career, was an Army surgeon, and in the Belleisle expedition, observing carefully the changes appearing in wounds, evolved many of his impressions regarding inflammation. In 1791, nearly thirty years later, he was selected from the ranks of the civil

profession, as was the custom at that time, to be Surgeon-General and Inspector of Hospitals, and died as a result of a disagreement with one of his colleagues. Apart from him no one appears, after Paré, to have achieved very much until the appearance of Larrey, Napoleon's surgeon, often spoken of as the greatest military surgeon that ever lived. Not only did he make great improvements in the medical service of the French Army—such as the establishment of what corresponds to the modern forward operating centre—but his surgical judgment and acumen were so great as to put him far ahead of his times. Indeed, when one reads of his principles and methods one cannot help feeling that he was little behind the best of present-day practice with all its additional knowledge. He excised wounds, removed foreign bodies, ligated arteries, aspirated and sealed chest wounds, used the skin of a newly flayed sheep for the same reason as we now use a hot-air bed in shock, avoided strong antiseptics in wounds unless they were sloughing, knew the value of good food and rest in the prevention of fatigue, knew the principle of rest in inflammation, of drainage, trephined for just the same head injuries as we do now (including post-traumatic disabilities), and operated on empyemata. In addition, his surgical technique must have been something to marvel at; at the Battle of Borodino he is credited with 200 amputations in twenty-four hours. He was the first to perform a disarticulation at the hip-joint, which Guthrie copied later at Waterloo. He has truly been called a benefactor of the human race.

In the same period of history many other Army surgeons of different nations evolved methods of enduring value and made discoveries, such as Dupuytren, Nélaton, Langenbeck, von Graefe, who was Surgeon-General in the German War of Independence and the founder of modern plastic surgery, and Pirogoff, the greatest Russian surgeon and one of the greatest war surgeons of all time, who introduced female nursing to the Army in the field in the Crimea. All of them are known to surgeons the world over as a result of their contributions to surgery. It appears to be no more than a coincidence that in the Crimea also Florence Nightingale on the English side did so much in the provision of trained female nurses in the base hospitals, following this up by establishing the modern system of trained nursing under which nursing became a profession instead of a calling. She did not, however, initiate female nursing in armies; this apparently lies to the credit of the Knights of Saint John, of Saint Lazarus and the Teutonic Knights who enlisted the services of women in their hospitals during the Crusades.

Since the Crimean War supermen in the field of war surgery and medicine have been few. Yet in the American Civil War the occurrence of "soldier's heart" was noted by Da Costa as due to such strains as may occur in civil life. The Franco-Prussian War might have supplied a testing field for Lister's theories of antisepsis and asepsis, so recently put forward, but his methods were then so complex that very little attempt

was made to try them. The South African War provided the incentive to find some means of reducing the crippling wastage from enteric fever. On the other hand, the relatively non-lethal rifle bullet then in use and the infrequency of shell wounds somewhat delayed the progress of treatment of wounds, leading to the adoption of a conservative plan of treatment. The Russo-Japanese War provided the opportunity for the Japanese to show the world that with strict rules and methods of hygiene deaths from sickness could be kept lower than those from battle, an example of some influence in health organization in civil communities and successfully followed by the British in the Great War of 1914-18, to which we now come, and in which deaths from sickness were less than those from wounds in all campaigns except those in Macedonia and Italy.

In the Great War it may be said that, while it was marked by no great discovery of principle in medicine, the benefit to mankind in many directions was enormous. Perhaps the greatest results followed the unprecedented opportunity of mass investigation of the value of methods up to that time improperly understood, under conditions controlled and ideal for observation —in other words, the greatest human vivisection experiments in history. The outstanding example of this was the preventive inoculation against typhoid and paratyphoid fevers. As a result these infections, which have been such scourges in past wars, notably in the Spanish-American War where 20 per cent of the troops were affected and 1·5 per cent died, and the South African War with only slightly lower proportions, in which 55,000 cases occurred and over 8,000 soldiers died, as well as in others too early for any statistical records, were almost abolished. In France in 1918 the morbidity was only 1 in 5,000, and the death-rate 1 in 100,000. In the worst and most uncontrollable theatre of war, Gallipoli, the incidence-rate was 8 per cent and the death-rate under 0·3 per cent.

No such convincing proof of the value of a method applicable to a disease always prevalent in some parts of the world could be obtained apart from war conditions.

The same applies to the prevention of tetanus, for, though it was carried out before the War to a limited extent, the tremendous lesson learned therefrom has resulted in its widespread use in the injuries known as likely to be followed by tetanus, a variety becoming increasingly common with the havoc caused by motor transport.

Not only did the War give the opportunity to explore such methods, but it caused the universal dissemination of their value through the vast army of doctors that was brought in contact with them. For it is a long journey from the discovery of a useful method to its recognition under normal conditions by the medical profession as a whole. And not only were new discoveries broadcast to the profession, but war service acted as a great post-graduate training in many subjects and methods of which much of the profession had insufficient knowledge. One of such was orthopædics, a branch which many avoid, with the result that patients do

not receive all the treatment that they might. It is largely to this that we owe the popularity of bone-setters and osteopaths, with the resultant development, in defence, of manipulative surgeons. A great deal was learned and taught regarding the repair of injuries to the limbs, treatment of nerve paralysis, artificial limbs and the like. The advantage of segregation of particular injuries and diseases in special wards or hospitals, such as fractures, chest and head wounds, meningitis, functional cardiac disorders and empyema was very manifest. The special fracture, heart, diabetic, rheumatic, tuberculosis and other clinics that are becoming such a feature, and a commendable feature, of modern medicine, owe their origin in no small degree to the example of this specialism of the War. Team-work, too, which we all recognize as productive of the best results, arises from the experience of the resuscitation, operating and various medical teams of the War. Another gain to the profession was the inculcation of order and method derived from the discipline necessary in the Army machine. Though in this, as in all other wars, there were many more cases of sickness than of wounds, it was in the field of surgery rather than of medicine that the most striking advances were made; and it is somewhat singular that, though a tardy recognition was accorded by the more enlightened in previous wars to the value of medical science in the prevention and treatment of disease, it is only in this last Great War that combatant personnel have come to a recognition of the value of good and prompt surgery in saving life and preventing wastage. There is practically no branch of surgery which has not directly or indirectly felt the benefit of war surgery. Consider what we know practically regarding the prevention of shock that we did not know before. Warmth, rest and tranquillity of mind before operation. And the treatment of shock and loss of blood. Nothing fundamentally new, but the wide knowledge of the wonderful life-saving value of heat, morphine, and above all, blood transfusion. Blood transfusion, instead of being confined to a few and a source of wonder to the laity, is now practised by the many whenever there is the slightest call for it. Certainly the technique has been much simplified since the War, but undoubtedly numberless lives have been saved through the post-war dissemination of the knowledge of blood transfusion, both before, during and after operation, and in hæmorrhage, the anæmias and as a general stimulant in exhausting and septic diseases.

There was a vast difference in the methods and results of treating wounds at the beginning and at the end of the War, and the knowledge gained is well applicable to civil surgery. At the outset a free use of antiseptics in the wound, as well as around it, was the approved method, and it was not long before the harmfulness of this treatment was recognized, as Hamilton Russell knew and taught before the War, and, as has been mentioned, did Larrey. Several other methods followed this, some of which persist, but the principle of aseptic rather than antiseptic treatment of wounds combined with early removal of foreign bodies and destroyed tissues

which is included under the term excision of wounds, warmth and unavoidable fatigue have brought us to the high-watermark of treatment of war wounds up to the present. And when we think of war wounds, we must picture not a simple cut, but a bruised, mangled, lacerated, dirt-ingrained, blood-starved welter, often associated with splintered bone.

Excision of wounds, which brought about such an entire change in the incidence of sepsis, and particularly of gas gangrene after wounds, and which saved countless lives, is one of the greatest legacies. It is not generally known that the originator of this method, though practised by Larrey and lost sight of, was a Melbourne graduate, E. T. C. Milligan. This procedure has a wide application in the civil surgery of injuries, and is now in everyday use.

Almost everything that is known of that dreadful disease, gas gangrene, was learnt in the Great War. Though it undoubtedly was the cause of great mortality in wars of the past where we read so often of "hospital gangrene," and of one instance in particular related by Paré when at the siege of Metz in mid-winter of 1552 practically all the wounded died, in civil life it was looked on as a rare disease of uncertain ætiology. We see more cases nowadays following industrial and motor accidents, and are in a better position to treat it, knowing that it is most prone to appear in damaged muscle tissue, especially where the blood supply is interfered with, and that it is mostly confined to single muscles or groups of muscles and must be treated by excision of the affected muscles. The anti-serum prepared late in the War for the specific organisms is in some cases very efficient; since the War it has been used with success in other conditions such as intestinal obstruction and peritonitis. There is some evidence that the serum may be valuable prophylactically, and a possibility that an anatoxin may be used to produce artificial immunity.

An early and valuable sign of the development of gas gangrene was recognized in the rapid and otherwise inexplicable increase of pain in the wound, accompanied by marked swelling.

In the field of chest surgery the use of X-rays was developed to recognize the amount of fluid and collapse of lung, the value of aspiration in hæmothorax became known, and the necessity for closing sucking wounds, while surgeons have become familiar with the manipulation of thoracic organs inside the open chest. Prior to the War this was a *noli me tangere* area, except with complicated apparatus like the Sauerbruch and other pressure cabinets. We learned the readiness with which the wounded heart can be repaired and intracardiac foreign bodies removed. From the huge streptococcal post-influenzal empyema epidemic in the American camps we gained a knowledge of the fatality of early thoracotomy in such cases and the limited application of the principle of repeated aspiration prior to rib resection in the commoner pneumococcal empyema; and also of the danger of too open drainage.

In the field of brain surgery advances were mostly in technique such as

local anæsthesia and the control of hæmorrhage by the "postage stamp" muscle application. But the principles were established of thoroughness of cleaning up, the necessity of removal of foreign bodies, drainage and post-operative rest. We recognized that the brain has definite powers of resistance to and recovery from infection, and it was the same in regard to the pleura and synovial membranes. A great deal also was learned regarding cerebral localization. In joints, the advisability of closure and the harm of drainage tubes were established, but this now seems to have been to a certain extent forgotten. The improvement in the treatment of fractures, remarkable as it was, was particularly notable in regard to the femur, the cause of high mortality in the early days of the War, where the Thomas splint replaced the unhappy Liston, and the efforts of Sinclair and Pearson showed what improvement in results could be brought about by specialization, thoroughness and team-work. Should the specialized application of pre-existing methods advocated by Böhler prove to be permanently acceptable to surgeons as an advance in treatment, this may be credited to war, for Böhler was a war surgeon impelled by the bad results in fractures as commonly treated to try for something better.

A tremendous amount was learned about the possibilities of plastic surgery of the face, and wonderful results achieved that were unheard of before the War. The application of this in civil surgery, though somewhat limited, is of definite value, and we owe it largely to Gillies, and others. The use of sliding muscle flaps, as practised in wounds of the chest and abdomen, must also be mentioned. Amongst minor gains is the application of maggots in acute osteomyelitis, the result of observation by an American surgeon, Baer, of the results in compound fractures of femora which became infested with maggots. It may be noted that Larrey was aware of this.

As regards venereal disease, no new methods arose, but much was learned from mass observation. Prevention of gonorrhœa was first attempted on a large scale and established; this was far from a new method, for Salicet practised it in the thirteenth century. Prophylaxis of syphilis was shown to be simple and successful, and the necessity for repeated courses of treatment and careful following up over a long period became more definitely understood. The Navy was responsible for much of this. The conclusion emerged from the large quantity of cases that present methods of treatment are very satisfactory.

When we turn to pure medicine, we do not find so many advances to signalize. Certainly a new disease, trench fever, was recognized and its cause discovered, but this seems to have no civil application. Trench nephritis, previously recognized in the American Civil War, gave an opportunity for observing acute nephritis in the mass, with the result that we know more of its prognosis, course and classification and the distinction from chronic degenerative and arteriosclerotic nephritis. Trench feet comes under the same category, a troublesome condition also referred to by Larrey. From the study of functional heart disabilities a great deal was learned, and again, not for the first time in war; and a large education

was given to the profession in the distinction beween functional and organic lesions and the vast difference in prognosis.

In psychiatry an unheard-of field of observation presented, and it was found that the War brought about little increase in true psychosis or insanity, though an enormous number of cases of psychoneurosis were treated, showing that even in war the psychic element is the dominant factor; for example, shell-shock.

We may claim the production of Haldane's oxygen apparatus and its modifications applicable to pneumonias and other lung conditions, carbon monoxide poisoning and heart failure, as due to the necessity of treatment of poison gassing.

The discovery of the cause of bilharziosis, so terribly prevalent in Egypt, by Leiper, and its curative treatment by Christopherson, both Army medical officers, were of far-reaching importance. Though bilharziosis has not become endemic in Australia, we may consider it good fortune that it has not, as all the necessary factors for its establishment were present after the War.

Much was learned of the treatment of the dysenteries, of bacillary dysentery by the sulphates and antiserum, and of amœbic dysentery by emetine, as well as a great deal about the microscopic diagnosis in both.

Malaria was the greatest single cause of sick wastage, and something was learned of details of treatment and still more of the methods of prevention of mosquito breeding.

Practically all we know of encephalitis lethargica has been discovered during and since the War. Though it has probably occurred before, in England perhaps in 1685, it was not recognized until 1917. It is one of a group of diseases to which cerebrospinal fever and poliomyelitis belong, in which the pathological agent is frequently present in the human being without causing an attack of the disease until the balance between the virulence of the virus and the immunity of the individual goes in favour of the virus. It is probable, too, that as was found in the case of cerebrospinal fever, an epidemic does not occur until the carriers reach a definite percentage—in the case of cerebrospinal fever about 20 per cent. A far more common and important condition is avitaminosis, and we are indebted to the Great War for a great deal of our present knowledge of its effects and treatment, even if unhappily much of it has come from study of the effects of starvation of children in beaten countries and of prisoners of war.

In anæsthetics the use of local injections was popularized, and the unfavourable after-effects of long ether anæsthesias were recognized as well as the important advantages of nitrous oxide, already well known in the United States, but very little in Great Britain and Australia.

Apart from a chronological survey of the benefits arising from war, it is well recognized what a difference has been made to life in the tropics by the efforts of Army surgeons. Most of the insect vector discoveries are a result of military organization, and the methods of avoidance of tropical

diseases are due to military hygienists. Malaria, one of the greatest causes of illness and death in modern history, a determining factor in the history of the world, the cause—partial at least—of the decay of Greece and Rome owing to the slow but steady infection with the malignant tertian variety, the cause of the disappearance of the Moghul empire and the kingdom of Ceylon and the winner of many wars, was found by Laveran to be caused by a plasmodium. In 1897 Ross, labouring in the face of official opposition, discovered its transference to man by the anopheles mosquito, and opened the way to its prevention, while the Spanish conquests in South America had in the time of Ferdinand and Isabella brought quinine back to Europe.

Yellow fever, for centuries the cause of fearful mortality in the Americas, was found by Major Reed to be due to the Stegomyia mosquito. Gorgas, who later made the Panama Canal possible by his fight with malaria, in eight months in 1901 freed Cuba of yellow fever by attacking the Stegomyia and isolating fresh cases, and this successful eradication started by Army surgeons has been widely and successfully adopted for both yellow fever and malaria.

Rogers, another Army surgeon, was responsible for the valuable hypertonic treatment of cholera which has saved many lives, a method applicable to the heat cramps occurring in hot mines when water is drunk too freely, and to the loss of chlorides in intestinal obstruction.

One of the great health problems of life in the tropics has always been the effects of high solar temperature which manifest themselves in different forms commonly known as heat exhaustion, heat stroke and sunstroke. There has always been a great deal of confusion as to the exact meaning of these terms. An excellent opportunity of controlled investigation in the mass presented itself in Mesopotamia, and, while it cannot be said that finality has been reached, a great deal has been learned on the subject and a number of empiric beliefs have been demolished. Of still more importance has been the recognition of certain premonitory symptoms of heat stroke which, if followed promptly by the methods of treatment there worked out, has brought about the position that fatal results can almost always be avoided. With this let me bring the account of the benefits of war to a close, though the field has but been skimmed.

Enough has been said, I think, to establish my thesis that medical science and practice have had through the ages much for which to be grateful to war. Let us hope for an era when progress may be equally rapid without the evils of war.

If now we turn to the other side of the picture and ponder on the benefits of medical progress to war, we are brought up by the wonderful amount of knowledge now available to a commander in the field to keep his army intact as compared with the general of all past ages. As many wars and battles, if not more, have been decided by disease than by force of arms. Let us mention some of the most striking out of the many. Sennacherib, the Assyrian, in the eighth century B.C., with his host was

struck by the "Angel of the Lord" so that in a night he lost 150,000 men and was forced to depart. Probably this was some epidemic. When Xerxes was marching on Greece with an army of 800,000, the Greeks were saved by an epidemic—perhaps plague and dysentery—which attacked him and which forced him to return to Persia, without fighting, with less than half a million men.

The Crusades furnish perhaps the most dramatic known instances of disease. The first, in 1098, gives us a force of 300,000 besieging Antioch and then Jerusalem, reduced in two years to some 20,000 almost entirely by disease. Of half a million who set out on the second Crusade, disease accounted for all but a handful, if any, who returned to Europe. Plague, and not the Saracens, prevented the fourth Crusade from reaching Jerusalem. In more recent times the French in Haiti lost 22,000 out of 25,000 men, enough to allow the negroes to turn them out of the island, while the English at Cartagena, in one of the hopelessly mismanaged expeditions that distinguished our military history of the eighteenth century, lost nine out of every ten men that set out. The failure of the Walcheren expedition from malaria is perhaps the best-known example of this kind in English history.

In these and other examples of disease-won campaigns it is not always possible to identify the epidemic, but the chief killers we recognize have been plague, smallpox, typhoid, typhus, malaria, dysentery and possibly influenza. Of plague, which in the fourteenth century destroyed perhaps twenty-five million people in Europe, we now know the cause and how to prevent, if not to cure it. Smallpox we can more actively and easily control, given the time and material. Dysentery, too, with much trouble can be checked, but influenza, whether of recent or ancient origin, is beyond our powers both of prevention and treatment, and this alone of all great epidemic diseases caused more loss of human life in the great world epidemic of 1918 than did battle casualties in the Great War. The control of typhoid and malaria I have laid claim to as largely a result of war.

In the view of many typhus fever has been the greatest killer in history. It has decided wars, ended them without decision, and prevented wars, yet war did nothing to rid mankind of this scourge. Not until 1909 was it demonstrated by Nicolle that the louse was the carrier of typhus, the knowledge that the virus lay in the Rickettsia bodies and that in some circumstances the rat flea could act as host for the virus following in the ensuing years. It appears most probable that typhus fever came from the East to Europe. When it first made its appearance is conjectural; with the lack of medical knowledge of the early middle ages this is not surprising, for the disease does not display particularly distinguishing characteristics. Even in present times it remains undiagnosed. In 1898 a disease known as Brill's disease appeared in the north-east of the United States of America and continued for twenty-eight years before it was recognized as typhus by a doctor who was familiar with its manifestations

in Europe. Then, too, in early times the descriptions of epidemics of obviously more than one disease make their recognition nearly impossible. It has been thought by some that the Athenian fever of the Peloponnesian War was typhus, but this cannot be regarded as proven. The first description of an epidemic which can reasonably be recognized as typhus was in 1083 in Italy, and it is not again in evidence till the end of the fifteenth century. Its first known great political effect was in 1528, when it caused the abandonment of the seige of Naples by the French and brought the Papal State under the dominant influence of Spain and thus altered the subsequent history of Europe. From that time onwards we find it a companion of the constant wars that ravaged Europe for the ensuing centuries, playing a greater part than the arms of the combatants in slaying friend and foe, frequently deciding the issues between the warring States and decimating the unfortunate civilians.

It is a remarkable and largely unexplainable phenomenon that in the last and greatest of wars, with the exception of the outbreak in Serbia in the early months which so checked the Austrians in their invasion, the disease was practically non-existent in the millions fighting in Western Europe. The louse was as constant as in other wars, and the cause of other diseases, but for some unknown reason typhus did not appear in circumstances so favourable for its spread.

Had it done so, the discoveries of medicine had placed in the hands of the Armies the knowledge to control the ravages of the disease so apparent in the past, even if not yet to cure it. Perhaps a cure may result from other wars.

But apart from disease medical knowledge has done much to prevent that all-important loss of man-power by teaching what is necessary in the constitution and amount of the soldier's food ration if he is to maintain his strength and resistance to fatigue, loss of morale, and disease. Scurvy has been banished, the voyages of Captain Cook being not without influence in this achievement, and beri-beri and pellagra, which became almost universal in the Turkish Army in Syria in 1918, can be avoided. None the less proper clothing, amusement, rest and cover from the elements such as of old were deemed necessary for his steed or hound and not for his men, are now by experience and precept as great a necessity for a true commander as are training and munitions. For this, medicine must take some credit. And, last of all, prevention of sepsis in wounds, however perfect by empiric knowledge, could never have persisted had not its true cause been patiently and certainly unveiled.

Perhaps some day we may traverse the path of learning still further and find what manner of disease it is that causes man to go to war on man.

ACKNOWLEDGMENTS.

My thanks must be expressed to many of my professional brethren who have discussed this subject with me and helped me greatly with suggestions and references to literature.

Editorial.

YELLOW FEVER.

In an Editorial on yellow fever in the December number of the Journal, 1935, we pointed out several new developments in the epidemiology of this disease. It seems to be definitely proved that yellow fever can exist in the endemic state in the absence of human beings, and that it can be transmitted in the absence of *Aëdes aegypti.*

It has been suggested that monkeys may be the foci of the disease, which may be carried from them to man through the agency of mosquitoes, especially *A. scapularis.*

In the July number of the Journal issued by the Office International Publique in 1936 there are published reports on yellow fever received during the six months ending March 31, 1936.

In the note presented to the Permanent Committee by Colonel S. P. James, F.R.S., in the session of May, 1935, it is pointed out that the old epidemiological conception of man as the sole source and the sole reservoir of yellow fever and *A. aegypti* as the sole insect vector must be reconsidered. The conception was true enough for the form of yellow fever (called now urban yellow fever) to which it was applied, but it is not true for two other forms which have appeared during the last three years in South America. These two varieties exist in endemic form in the complete absence of *A. aegypti.* One of them, called "rural" yellow fever, is found in strictly rural regions in which the human population is sufficiently numerous and sufficiently dense to justify the assumption that the infection can pass from the vector to man and from man to the vector. The other variety, called "jungle" yellow fever, exists in forests and areas on the banks of rivers, where the people are too few to render it possible that they could be the focus of infection.

According to Dr. Soper the yellow fever transmitted by *A. aegypti* is a disease of the house or the family: a disease which is acquired by non-immune persons living in an infected house or who go there on a visit. The yellow fever of the jungle is not contracted in houses, but in the forest, or jungle, or in fields situated close to regions which have not been cultivated; the only members of the family infected are those who work in these places or visit them. Thus, in an epidemic in the valley of Chanaan, two cases of jungle fever were observed in one family; they were the father who worked on the land and a son, aged 7 years, who used to accompany him. During their illness they were treated at home, but there was no other case among the twelve members of the family living in the house. In an epidemic of thirty-seven cases, with twelve deaths, at

Caparrapi, all the cases were amongst agricultural workers in a valley being prepared for planting. There were no cases amongst their wives and children.

Similar outbreaks are quoted in a small village at Burity da Conceiçao, and in the State of Para, where the affected men lived in temporary structures on the banks of rivers far from any town. In support of his statement that the jungle variety attacks chiefly workers on the land, Dr. Soper states that there are many more cases amongst men than among women, and the great majority of the men are of an age when they would be likely to work on the land. Dr. Soper sums up by saying that yellow fever of the jungle is a "professional illness" associated with work on the land—as opposed to urban yellow fever which is contracted in houses and mainly in the hours of repose.

The fact that jungle yellow fever appears in workers on freshly tilled land in regions which have never been occupied by man is strong evidence that man is not an essential factor in the persistence of endemicity. The fact suggests that man can only be regarded as an accidental factor in the course of an epizootic amongst animals. This idea is supported by the discovery that three different kinds of monkeys captured in South America in widely-separated regions have an acquired immunity against infection with yellow fever.

As regards the insect vectors of yellow fever several mosquitoes other than *A. aegypti* (which has not been found) have been observed in the jungle regions, especially the genus *Haemagogus*. The blue mosquito *Haemagogus equinus* is very prevalent, and has a great predilection for man. Experiments in the laboratory have proved that the virus of yellow fever can be transmitted from monkey to monkey by these mosquitoes. The virus of "jungle" yellow fever has been isolated from human cases in Brazil, and its action studied on monkeys and on mice. It appears to be identical with the virus of "urban" yellow fever and is transmissible from monkey to monkey by *A. aegypti*, as well as by other mosquitoes. No clinical or pathological differences have been observed between the two types of yellow fever. The results obtained by protection tests with the serum of cured cases of the disease, as well as by the histological examination of specimens of liver tissue obtained from fatal cases are identical.

It is thought that eventually the study of "rural" yellow fever occuring in the absence of *A. aegypti* will show that its epidemiology is the same as "jungle" yellow fever.

As regards clinical forms of yellow fever the practice of viscerotomy has shown that beside the slight forms which the clinicians cannot diagnose, there exist fatal forms in which the clinical signs would never suggest yellow fever. Among other forms there is one in which symptoms and lesions of the nervous system predominate. In 1934, Stefanopoulo and Mollaret published an account of a case of yellow fever in which hemiplegia

and other nervous symptoms appeared. More recently in Africa several cases have been reported in which the central nervous system was attacked. In the May 1936 session of the Permanent Committee, Medical Inspector General Sorel reported on a series of yellow fever cases in the French African Colonies. In the year 1935 there was no true epidemic in these Colonies. There were only fourteen cases compared with twenty-three in the preceding year. The cases had no connexion with one another, appeared at all times of the year and in different regions. Three Europeans and one Syrian were attacked, the remaining cases were natives. One case, a European, with symptoms of Landry's paralysis, did not give rise to any suspicion of yellow fever, yet the liver showed hepatic lesions characteristic of yellow fever. It appears that this man had been eleven months on the Ivory Coast, and had never been vaccinated against yellow fever. During eighteen days he complained of lassitude with gradually increasing headache. The headache became so severe that he was sent to hospital. He then had paralysis of the limbs and could not stand upright. The paralysis gradually ascended ; reflexes were suppressed ; but sensation was preserved. Malaria parasites (vivax) were found on examination of the blood. The liver was slightly enlarged. The urine was normal. Landry's syndrome was diagnosed. Quinine was given on account of the presence of the malaria parasites. He died six days after admission to hospital when paralysis of the phrenic nerve occurred. At the post-mortem examination the liver showed changes absolutely typical of those found in yellow fever.

These facts were somewhat disconcerting by their novelty. The first question that arose was as to the specificity of the lesions in the liver. The preparations of the liver were examined by Dr. Bablet and Dr. Soper and they both declared that the microscopical appearances were typical of yellow fever. The existence of yellow fever being considered beyond doubt, it was suggested that possibly this was a case of yellow fever grafted on to a developing syndrome of Landry's paralysis. If the case was the result of yellow fever virus acting alone, then it had to be admitted that in natural conditions the virus had the power of attacking the central nervous system in a marked degree, while at the same time preserving a viscerotropic character sufficient to produce characteristic lesions in the liver.

Dr. Sorel concluded his report with the suggestion that the clinical diagnosis of yellow fever should be made with great circumspection : it would be wise to declare that the case was sufficiently suspicious to justify the adoption of preventive measures until confirmation or otherwise had been received from the laboratory. He thought it would be desirable to examine fragments of medullary nervous tissue as well as specimens from the liver and kidney, in order to find out the possible changes produced by the virus of yellow fever. He considered this examination particularly important when individuals had died from some rapidly fatal nervous affection. Numerous cases of poliomyelitis, especially in native children,

had been reported in Africa and it was very necessary to find out the true nature of this affection, which up to the present had only been studied clinically.

In his communication Colonel James stated that it is not always correct to assume that localities in which the youngest donors of protective serum are of adult age are therefore free from yellow fever, and that it has not existed of late years.

In countries where jungle yellow fever exists it is equally important to note that the absence of immunity from the inhabitants of ports and towns does not indicate that the districts, where these towns and ports are situated, are also free from yellow fever. The mouse protection test carried out in the towns of the State of Matto Grosso did not reveal that yellow fever had previously existed, for among 1,055 tests only 1·6 per cent gave positive results. But when the enquiry was extended to neighbouring rural regions, the numbers of positive results were 53, or 71 per cent.

Colonel James also presented to the Committee a note on vaccination against yellow fever by Dr. Findlay. Since 1932, 951 persons have been vaccinated, 736 in England and the others in Africa. During this period mixtures of virus and immune serum have been used; the virus for two and a half years was the neurotropic yellow fever virus; for the last six months, with the co-operation of Dr. A. F. Mahaffy of the Rockefeller Foundation, current vaccinations have been made with a strain of viscero-tropic virus attenuated by prolonged cultivation on tissue (pantropic strain). 761 persons have been vaccinated with neurotropic virus; for 310 of these human anti-yellow fever serum was employed, and for 451 persons heterologous anti-yellow fever serum prepared from horses was used. The human serum did not produce any serious reaction, but after the horse serum there were two severe reactions: both persons fortunately recovered. Dr. Findlay, however, observes that a virus of high neuro-tropic affinity cannot be used without considerable anxiety; the barrier established varies within wide limits in the normal adult; it is probably reduced in young subjects, under the influence of menstruation, in encephalactic states and in persons suffering from inflammatory affections of the nervous system.

It is also possible that direct transmission through the walls of the blood-vessels is not the only way in which the virus can reach the central nervous system, for Findlay and Mahaffy have shown experimentally that the neurotropic virus can pass from the blood to the nasal mucous membrane whence it may reach the brain. Vaccination with the attenuated pantropic strain reduces to a minimum the danger of encephalitis, and (according to Findlay) this virus with human anti-yellow fever serum is the method of choice. None of the 195 persons vaccinated by this method has shown any serious reaction. Beyond a slight headache on the third or fourth day, none of the persons inoculated has complained of any illness, except one man who had an attack of mild follicular tonsillitis.

Two slight changes have been made in the technique described by Lloyd, Theiler and Ricci. Chicken embryo has replaced mouse embryo in the culture medium, and before converting the culture in the presence of tissue into vaccine, a single passage is made through mouse brain. The mouse embyro has been discarded because it was found that mice in England sometimes suffered from a lymphocytic chorio-meningitis. For the same reason only one passage is made through the brain of mice, specially reared and known to be free from virus disease. The emulsified brain is also passed through a Seitz filter.

After the injection of pantropic virus and human immune serum, free virus has never been found in the circulating blood.

Vaccination with the pantropic virus alone is not recommended, as it has been shown that the attenuated virus is easily reactivated.

Clinical and other Notes.

NOTES ON A CASE OF JAPANESE RIVER FEVER (TSUTSUGAMUSHI DISEASE) AND A CASE OF TROPICAL TYPHUS FEVER.

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AND

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The case is reported as the occurrence of this disease amongst British soldiers is sufficiently rare to warrant its publication.

The patient was Private L., the Middlesex Regiment, aged 26, service six and a half years. His medical history sheet showed no entries relevant to his present condition. His foreign service was: Palestine, fourteen months; Egypt (Cairo and Moascar), three years; Singapore, three months.

On June 18, 1936, he reported sick and was admitted to the Military Hospital, Singapore, with a temperature of 101·2° F., complaining of shivering and headache. He had been feeling out of sorts for six days but did not report sick.

On examination pulse and respiration were normal, the spleen was not palpable or tender, chest and abdomen were normal. He had slight sore throat and there was a whitish patch on the uvula. He had a small sore on the left ankle with an enlarged gland in the left groin.

His blood was examined for malaria parasites; the result was negative. The case was considered probably dengue and he was kept under observation and treated for dengue.

The following day he had a macular rash, distributed over the chest and abdomen and to a slight extent over the back and shoulders; the remainder of the body was unaffected. The rash was very suggestive of secondary syphilis; there was a history of exposure about seven months previously, but further examination showed no sign of primary sore and no general or epitrochlear glandular enlargement. Wassermann reaction was negative.

From this time onwards the temperature began to swing and frequent blood slides proved negative. Treatment was continued as for dengue.

On June 24 an intravenous injection of quinine, gr. 6, was given and the same dosage repeated the following day without effect on the temperature.

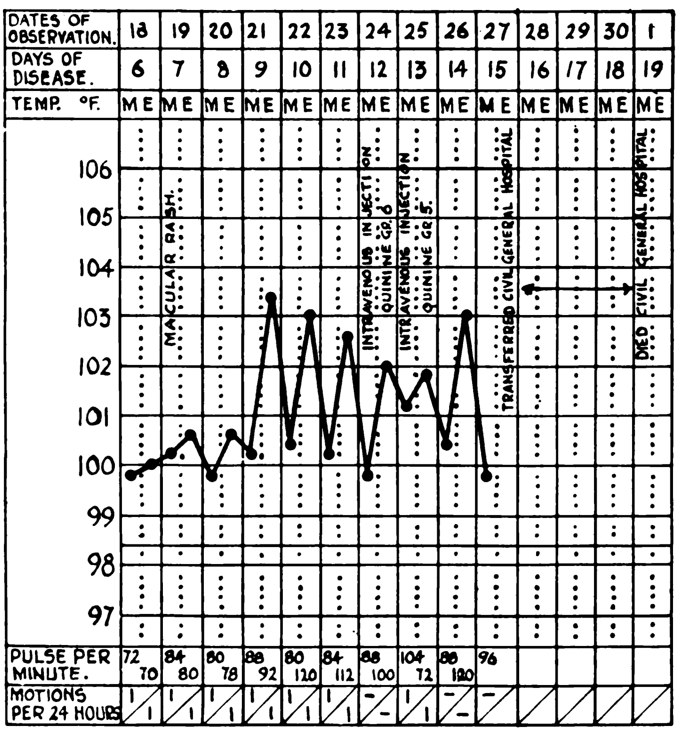
The rash continued the same, the patient was obviously very ill and complained of being very tired. Blood cultures were sterile; blood-counts were not suggestive of any septic condition.

On the 26th he was seen by one of us (E.U.) in consultation. The rash

was now beginning to fade; it was a dusky red colour; this together with the general lethargic condition of the patient was very suggestive of typhus fever.

On investigation, it was found that the patient used to go for walks by himself through pineapple plantations and that he received a scratch on the ankle during one of these walks.

June 27: Patient was very lethargic. Weil-Felix test showed agglutination against *B. proteus* (Kingsbury strain) 1 : 250 and the diagnosis of Malayan scrub typhus was made. The patient was then transferred to



the Singapore General Hospital, where he gradually relapsed into unconsciousness and died on July 1.

Post-mortem examination showed "general toxæmia and congestion of all organs, also petechial lung hæmorrhage with subpleural ecchymoses."

Laboratory examinations: Eleven examinations for malaria were carried out, all of which were negative.

The patch on the throat showed no diphtheroid organisms.

Five blood-cultures were sterile.

Blood-count: red blood cells, 4,810,000; white blood cells, 5,600. Differential count: polymorphonuclears, 88 per cent; small lymphocytes, 5 per cent; large lymphocytes, 3 per cent; eosinophiles, 2 per cent; transitionals, 2 per cent.

Sputum was negative for T.B.

Wassermann reaction was negative.

Serum agglutinations: T.A.B. group showed on the thirteenth day of illness: *B. typhosus*, agglutination up to 1:500; *B. paratyphosus* A, agglutination up to 1:5,000; *B. paratyphosus* B, agglutination up to 1:125. (Medical history sheet shows last inoculation for this group was in December, 1933, by two doses.)

Weil-Felix reaction: agglutination was carried out against strains of *B. proteus* OX19 and *B. proteus O. Kingsbury* (Warsaw strains not available). Dilutions carried from 1:25 to 1:5,000 showed no agglutination against OX19; but agglutination against Kingsbury was positive at 1:250.

Discussion.

What appeared to be the most striking and characteristic clinical features of the case were: (*a*) The temperature chart, showing a relative disproportion between the height of the temperature and the rapidity of the pulse-rate; (*b*) the general attitude of the patient which may be described as one of hebetude; (*c*) the duskiness—almost purplish colouring of the face; (*d*) the rash.

It is considered that the presence of these phenomena together is an indication for the performance of the Weil-Felix reaction, and that the patient's serum should be tested against the X19, W, and K strains of *B. proteus*.

The blood-count in this case is worthy of note, such a relatively high proportion of polymorphonuclear cells and a low one of lymphocytes being unusual in this disease.

It may perhaps be of interest to compare this case with one clinically typical of so-called Indian tick typhus which was under the care of one of the present writers some years previously and has not hitherto been published, of which a short summary follows:—

The patient, a N.C.O., aged 30, with eight years' total service, of which three and a half years had been spent in India, was stationed in Central India. No previous cases had been known to have occurred in the neighbourhood although cases had recently been described (by Megaw) in adjacent districts.

The patient had been out fishing about a month previously (date not exactly remembered) and also four days before the onset of the illness. He did not remember having been bitten by ticks, but a comrade stated that he had seen ticks on him after his return from fishing expeditions which necessitated walking through long grass and scrub.

The onset was gradual, with generalized pains, feverishness and malaise. A rigor occurred on the third day.

Fever lasted eighteen days, the temperature rising to a maximum of 104° F. on the fourth and fifth days, remaining about 101° F. from the sixth to ninth days, swinging, and gradually subsiding from the tenth to eighteenth

days. The pulse was slow in proportion to the height of the temperature (e.g. pulse-rate 80 with temperature 101° F.).

The fastigial stage of the illness was characterized clinically by :—intense congestion of the face and eyes, pains in the eyes aggravated by movement and acute tenderness of the eyeballs ; limb pains especially referred to the bones and neighbourhood of the joints; intense, profuse and universal rash ; marked drowsiness and enlargement of the spleen.

The rash, which was characteristic, appeared on the fourth day, first on the thighs and legs, then spreading rapidly to the trunk and face and soon becoming general and well marked. It was scanty on the face. At first (fourth to ninth days) the rash was a somewhat bright red in colour and maculo-papular and slightly raised in character. Later (from tenth day) it became darker in colour—a dusky red, almost purple and partly petechial. It slowly faded, persisting altogether for three weeks. There was no irritation. Limb pains persisted from the fourth to fourteenth day. Congestion of face and eyes lasted till the eighteenth day and drowsiness from the sixth till sixteenth.

The tongue was moist and raw, and for a time somewhat fissured, with patchy, flaky white fur for the first fortnight. It was never coated or dirty.

The spleen was palpably enlarged from the seventh to the twenty-fifth day, at its greatest being two fingerbreadths below the costal margin between the tenth and fifteenth days.

There were no characteristic abdominal signs; but between the tenth and thirteenth days the abdomen was slightly distended, with a little pain and slight tenderness on the right side. Vomiting occurred on two occasions.

Bowels were regular throughout the illness, motions being slightly hard in the earlier stages.

Slight bronchitis was present from the eighth day and did not clear up until the twenty-sixth day.

Slight deafness with mental dullness were present at the height of the illness (seventh to fourteenth days) with evening delirium on the tenth and eleventh days. Slight enlargement of the sub-occipital and both inguinal groups of lymphatic glands was noted.

Blood-counts performed on the sixth and twelfth days gave results within normal limits: 34 per cent lymphocytes being noted on the former occasion, and 28 per cent on the latter. Blood cultures on sixth and eighth days were sterile.

Widal reaction: (patient had been inoculated with one cubic centimetre T.A.B. exactly twelve months previously).

Day		T.	A. (Standard	B. Agglutination	C. Units)	O.
6	..	21	53	57	0	1 : 50
8	..	21	53	57	0	1 : 50
13	..	58	60	100	0	1 : 25 and 1 : 125 but not 1 : 50
19	..	58	53	56	0	Not tested
26	..	43	53	100	Not tested	0

WEIL-FELIX REACTION.

Day		*B. proteus* X19	*B. proteus* Warsaw	*B. proteus* Kingsbury
6	..	Total 1 : 50	Total 1 : 50	Trace plus 1 : 50
13	..	Total 1 : 250	Standard 1 : 250	Trace 1 : 125
19	..	Trace 1 : 250	Total 1 : 250	Trace 1 : 50
26	..	Standard 1 : 25	Total 1 : 50	Trace 1 : 125

Bacteriological examinations of ten specimens of fæces and of twelve of urine were negative for organisms of the enteric group.

Marris' Atropine Test performed on the ninth day was negative, the average acceleration of the pulse over fifty minutes being 15 beats per minute.

Russo's Test and Ehrlich's Diazo Reaction were positive on the eleventh day.

By the fifth week the patient was convalescent, and thereafter recovery was uneventful and uninterrupted.

The bacteriological investigations and chemical reactions of this case were performed by Major F. J. Hallinan, R.A.M.C., to whom grateful acknowledgment is made.

Typhus fever exists in Malaya in three forms: (1) "W" Shop or urban typhus; (2) "K" Rural or scrub typhus; and (3) Japanese river fever.

"K" Type and Japanese river fever, as it occurs in Malaya, are identical, both clinically and serologically; the only difference is that in Japanese river fever there is an eschar and lymphangitis that is sometimes very difficult to detect.

The incidence of this fever in Malaya is not confined to oil palm and rubber plantations or new jungle clearings. It may arise in areas formerly devoted to agriculture and mining, especially when these areas are overgrown with secondary jungle and long grass.

The disease is generally more severe in Europeans than in Malays.

The vector in Malaya is believed to be *Trombicula deliensis*, a mite resembling the red harvest mite of Great Britain, but this is not definitely established. Rats harbour these mites, and one writer (Anigstein) regards rats as a virus reservoir of the disease. This view is supported by the observations that in some endemic areas, 10 per cent of wild rats give a well-marked Weil-Felix reaction. There is no evidence that the human louse plays any part in the spread of this disease.

The Widal reaction is of interest in this case and is unusual, though O'Connor reports positive reactions in fifteen of eighty-five cases. The agglutination of *B. paratyphosus* A to 1 : 5,000 may be due to a heterologous reaction; this was noted by Wilson in 1927.

Only one Weil-Felix reaction was carried out in this case, and this on the thirteenth day of the illness (allowing that the patient was ill six days prior to admission).

It is unusual for the reaction to be positive before the eighth day of the illness, but it is well established by the end of the second week and reaches its peak on the seventeenth day. A positive agglutination as low as 1 : 125 is generally considered as diagnostic.

The last recorded case of typhus in Malaya amongst the military population occurred in 1924 at a small convalescent camp near Kuala Lumpur, when six cases occurred.

The disease is very rarely reported in Singapore Island, though it is endemic in various parts of Malaya.

We have to thank Lieutenant-Colonel O. W. McSheehy, D.S.O., O.B.E., M.B., R.A.M.C., O.C., Military Hospital, Tanglin, and Colonel E. Gibbon, O.B.E., M.B., Assistant Director of Medical Services, Malaya Command, for permission to send these notes for publication.

Since these notes were written, a further case of Japanese river fever in a soldier has been reported. The patient is still under treatment and belongs to a different unit from the case just described.

Echoes of the Past.

WAR EXPERIENCES OF A TERRITORIAL MEDICAL OFFICER.

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(*Continued from p.* 347.)

Chapter XVI.—Preparations for the Advance.

After our move to Fukhari on September 3, the preparations for the next offensive were seriously set in motion.

A scheme for the resumption of active operations had been drawn up by Sir Philip Chetwode and the Staff of East Force before the arrival of Sir Edmund Allenby in Palestine and received his approval with a few subsequent modifications.

The main idea was to hold the line of trenches opposite Gaza with the 21st Corps, and after a secret concentration of the 20th and Desert Corps on the Wadi Ghuzzeh near Shellal, to make with them a surprise attack on the defences of Beersheba. If this were successful, there was to be a rapid move to the north-west to attack the defences of Hareira and Sheria with the object of crushing and turning the enemy's left flank and by threatening their communications to force them to evacuate Gaza. At the same time the town of Gaza and its defences was to be subjected to a very heavy bombardment, and the 21st Corps was to demonstrate against the garrison so strongly that the latter would be prevented from sending reinforcements

to the left flank. Their attack was not, however, to be driven home until Beersheba was taken and the left flank turned.

The details of the scheme were worked out with great care.

The medical preparations involved:—

(1) Reconnaissance for the selection of the sites for dressing stations and routes of evacuation.
(2) Selection of a site for the three casualty clearing stations attached to our Corps.
(3) Preparation of a scheme for the evacuation of casualties.
(4) Scheme for the chlorination of all water to be issued to troops during the operation.
(5) Instructions as to sanitary measures to be adopted by troops during active movements.

Shellal, the starting point of the operation, was seventeen miles from Beersheba. Much of the intervening ground was flat and under direct observation from the enemy's positions at Hareira and Kauwukah. Examination of the ground could, therefore, only be carried out during reconnaissances in force.

Five separate reconnaissances were made between August 24 and October 3. On each occasion a cavalry screen was thrown out in front of our lines to within a few miles of Beersheba and by degrees we explored practically every track in the area suitable for motor ambulances, selecting the best routes for evacuation of wounded from the various parts of the line to be attacked. On the first occasion we went in a motor ambulance in order to make a practical test of its ability to negotiate the tracks, but afterwards the Corps Commander decided that motor ambulances were not to be used for this purpose in case it should be considered a breach of the Geneva Convention.

The Wadi Ghuzzeh at Shellal forms a remarkable geographical feature. From bank to bank it is more than a mile wide, though the stony bed of the stream itself is generally only ten or twenty feet across. The rest of the Wadi is occupied by a confused mass of hillocks and gullies produced by the action of water in storm time on the soft sandy soil. The bed of the stream, which is about thirty feet below the surrounding country, is dry and stony except during the rainy season. There are, however, all the year round patches where springs come to the surface and produce shallow pools from which the water trickles along for a few yards above ground and then disappears again beneath the stones.

At Shellal itself there is a succession of such springs and pools. A small dam had been built here by the Royal Engineers across the bed of the stream just below the most important group of springs forming a reservoir capable of holding about a million gallons. The overflow from the dam formed a small but steady stream which was used for watering animals. A pumping station was erected by the side of the reservoir and a pipe line was carried forward from it to the far edge of the escarpment.

Water from these springs contained about two hundred parts of salt per hundred thousand and was distinctly brackish, so much so that its taste could not be disguised by tea or coffee. However, it was just drinkable and was used almost exclusively by the troops during the early part of the subsequent operations and without any apparent ill-effect. Animals drank it readily when once they had become accustomed to it.

A road bridge was made by the engineers across the bed of the Wadi just below the dam, to be used in case the wet season came on before the operation, but was not needed.

The crossing of the Wadi by a large force was no small undertaking. The steepness of the sides of the escarpment and the friableness of the soil made the maintenance of roads for wheeled transport a troublesome and continuous business. A special road had to be kept for motor cars as those used by horses and transport vehicles soon became impassable for cars.

The country beyond the Wadi, for the first few miles, was a wide undulating arable plain. It had been chiefly used for growing barley, but this year no seed had been sown, so it was sprinkled with ungathered, self-sown crops.

Gradually, as one proceeds in the direction of Beersheba, the country becomes more irregular and within a few miles of the town distinctly hilly. The little town of Beersheba is situated on one of the two main tributaries of the Wadi Ghuzzeh, called the Wadi Saba. It lies in a hollow of the hills which completely surround it except where the Wadi makes its way southwards between them. They rise some three hundred feet above the floor of the basin and completely shut out the view of the town from the south. The southern and eastern defences were on the crests of these hills some two miles from the town.

The country to the east of the Wadi Saba and to the south-east of the town is extremely broken and quite impassable for motor cars, except by a road which goes a long way round through Khalasa. The map of the country used by us was a reproduction of the one made originally by Lord Kitchener, when a subaltern, for the Palestine Exploration Survey. The various tracks were most accurately shown. At the time of reconnaissance, and for the first two days of the operations, the roads and tracks, nowhere metalled, were well defined and quite fit for motor traffic, but the passage of large bodies of mounted troops and wheeled vehicles soon broke up the hard mud surface into loose sand and rendered them almost impassable.

As the main attack was to be on the east side of the Wadi Saba, we made many attempts to find a track on that side fit for motor ambulances, but without avail. It was, however, an immense relief to find that the main routes to Beersheba were suitable for cars. We had been told by the General Staff Intelligence Department that it would be impossible to use motor cars, which would have meant bringing back the wounded fifteen miles in sand carts or on camels—a very serious business. Fortunately,

we found when we went to see for ourselves that their fears were not justified. This was a good example of the importance of administrators in charge of departments making their own personal reconnaissances.

It was decided to pitch the Casualty Clearing Stations on the open plain close to the north bank of the Wadi Ghuzzeh, near the point where the railway reached the top of the escarpment. This point was in full view from the Turkish position at Hareira at a distance of about six miles.

To have erected tents there for three hospitals before the operation began would have given the whole show away. It was decided, therefore, that a railway siding should be constructed, the ground marked out and all the stores put in position beforehand, but that no canvas should be raised until after dark on the evening before the attack. It meant very hard work for the staffs of the hospitals who would have to begin to receive casualties almost as soon as the camps were pitched after working all night. When the time came it was successfully accomplished and one will never forget one's first view on the morning of the battle of the little town of tents standing on what had been an empty plain the previous evening.

The general principle of the scheme of evacuation for the operation against Beersheba was :—

(1) A medical railhead at Imara with three casualty clearing stations and an Egyptian hospital for the reception of Egyptians and prisoners of war.

(2) All the motor ambulances of the Corps were to be massed under the direct control of the D.D.M.S.

(3) Each Division was responsible for the transport of its casualties, by means of camels and sand carts to the main dressing stations whence they would be removed by the motor ambulances to the casualty clearing stations.

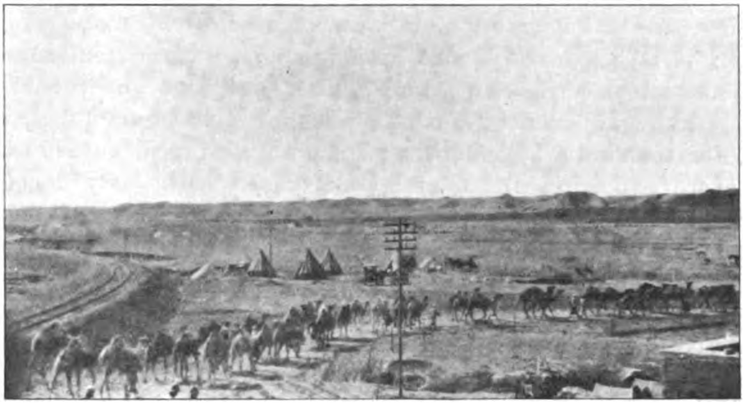
(4) The routes to be used were carefully marked on special maps and the important turnings indicated by signposts erected beforehand.

The officers in charge of the motor convoys were taken over the ground during the reconnaissances and a proportion of the drivers also. The mobile sections of the field ambulances, grouped together for each division, were held in reserve at Imara, ready to be moved forward to Beersheba or elsewhere as required.

A system of communication by means of motor cyclists was established between the A.Ds.M.S. of divisions and the D.D.M.S. who was himself in telephonic communication with the casualty clearing stations.

The country between Shellal and Beersheba was waterless save for a few scattered cisterns. It was necessary, therefore, to arrange for water to be sent out to the troops by camel convoy. During the first period the *fanattis* or water cans were filled from the springs in the bed of the Wadi Ghuzzeh at Shellal, then from a reservoir at Imara, and later still, when the pipe had been carried forward, from tanks at Karm, a new railhead five miles nearer to Beersheba.

Arrangements were made to have the water chlorinated before issue at each of these places by the addition of the necessary quantity of bleaching powder solution to each of the *fanatti* as they were being filled. This arduous duty was carried out by members of the various divisional sanitary sections and went on day and night during the whole period of the operations. A party was also held in readiness to chlorinate the water from the wells in Beersheba as soon as they should come into our possession.



Camel Water Convoy.

As regards sanitation, each unit of the Corps was provided with a portable sanitary outfit consisting of a minimum number of latrine buckets with fly-proof seats to rest on them; a number of urine funnels, the pointed ends of which were sunk into the ground over pits filled with stones to provide a rapid sub-surface absorption; and a portable incinerator for the destruction of the pail contents by fire. One camel was allowed to each unit for the carriage of this equipment. Some units were careless and lost or broke their equipment, but on the whole it proved a great boon and saved much soiling of the ground. The idea of this portable sanitary equipment was worked out by Major Lelean, at this time D.A.D.M.S. of the 20th Corps. It had first been used in the desert campaign of the previous year. When the equipment was not available, units were instructed to use trenches with careful earth covering of excreta.

(*To be continued.*)

Current Literature.

SMYTH, H. F., SMYTH, H. F., Jr., and CARPENTER, C. P. **The Chronic Toxicity of Carbon Tetrachloride: Animal Exposures and Field Studies.** *J. Indust. Hyg. and Toxicol.* 1936, v. 18, 277-98. [23 refs.]

Carbon tetrachloride is extensively used as a solvent in dry cleaning, degreasing, and fat extraction, because of its low cost and non-inflammability; it is also used in fire extinguishers. An extensive series of experiments are described in which guinea-pigs, rats and monkeys were exposed to known concentrations of vapour for eight hours a day, five days a week, for ten and a half months: some animals received 225 exposures. With severe exposures the liver was attacked with fatty degeneration, advancing to typical fibrotic hobnail liver, if the exposure was continued. The kidneys and adrenals were also similarly damaged. If, however, the exposures were not extreme, but were continued, the damaged cells rapidly regenerated, when the new cells were more resistant than normal to the vapour. Guinea-pigs were less resistant than rats and monkeys. A number of observations were made of occupational conditions of men at work: and ninety-six men exposed to carbon tetrachloride in industry were studied. The conclusions arrived at are that vapour concentrations of 100 per million are safe for continuous exposure at work, that 1,000 per million is safe for half an hour a day, and that under reasonable conditions of ventilation and care men increase their resistance with exposure. Men exposed to risk should be medically examined at least twice a year, when determinations should be made of icteric index, blood calcium and visual fields: differential white cell counts should also be made. With intelligent supervision no worker need be injured by carbon tetrachloride.

E. L. COLLIS.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 10.

FORBES, D. **Isolation of Scarlet Fever in the Home.** *Lancet.* 1936. June 20, 1438-39.

In Brighton, Dr. Forbes, the Medical Officer of Health, has carried out the policy of home isolation of cases of scarlet fever for four years and in this paper records the results. Home isolation was carried out if patients could be nursed in a room by themselves or in a room with their mother in a separate bed. Whereas 892 home nursed cases were associated with 29 secondary cases and 5 return cases, 725 hospital cases were associated with 7 secondary cases and 34 return cases. In addition to the marked difference between the return case rate in the two groups, there were only 3 secondary cases during th first fortnight after removal to hospital of the hospital nursed cases, whereas there were 21 among the contacts of the

home isolated cases at the same period. When the number of secondary infections (including return cases) is calculated in each group according to the number of school contacts at risk of infection, Dr. Forbes found that 5 per cent of contacts of home nursed, and 5·1 per cent of hospital nursed cases were infected. It is also stated that equal percentages of mothers were infected whether or not the child was removed to hospital. The saving to the local authority was estimated at £1,000 per annum, and Dr. Forbes makes the extremely interesting statement that his practice as regards school exclusion of contacts is the same for home nursed as for hospital nursed cases, viz., till the Monday week following isolation of the patient. Thus there is no excessive loss of school attendance to debit to the home isolation method. The relatively high return case rate associated with the hospital isolated group is attributed to the continuous reinfection which occurs among convalescents. Dr. Forbes believes that home isolation is justified by the non-exposure of the patient to cross infection and his relatively low infectivity at the end of isolation, and the saving in cost. A. JOE.

Reprinted from "Bulletin of Hygiene," Vol. 11, No. 10.

GUNN, W., and RUSSELL, W. T. **Immune Measles Sera in the Control of Measles Outbreaks in the Council's Hospitals, Institutions, and Residential Schools**. In *London County Council: Measles. Report of the Medical Officer of Health and School Medical Officer on the Measles Epidemic, 1933-34* [MENZIES, F.]. 1936, 24-54, 1 fig. and 1 chart.

This is a detailed report on the use in L.C.C. hospitals and institutions of measles immune sera in the prevention and attenuation of measles. The results were compiled from the records of 1,874 individuals receiving either adult immune or convalescent serum, and all except 8 were under observation in institutions. When complete protection was sought 5 cubic centimetres of convalescent or 10 cubic centimetres of adult serum were given to those under 3 years of age within six days of exposure, and for attenuation these amounts were recommended to be given on or after the sixth day. For children over 3 the dose in cubic centimetres for convalescent serum was calculated by multiplying the age by two, whilst for adult serum double the dose as for convalescent serum was given. In children who received adult serum with a view to securing complete protection, this was successful in 78·2 per cent, whilst when the same object was sought by convalescent serum, a protection rate of 80 per cent was obtained. In assessing the value of these results attention is drawn to the fact that in a previous epidemic 25 per cent had escaped attack whether injected or not. When attenuation was sought by adult serum this was successful in 38·5 per cent of instances, complete protection occurring in 52·3 per cent and the disease being uninfluenced in 9·2 per cent. The corresponding figures when convalescent serum was used were 54·3,

42·9, and 2·9 per cent respectively. The authors are at a loss to account for the fact that in securing complete protection the previous experience that convalescent serum was definitely superior to adult serum has not been confirmed by the present statistics. Adult serum with an attack-bleeding interval of under 10 years gave a protection rate of 100 per cent, and it is suggested that the less this period is the more potent is the serum. To obtain complete protection serum should be given within six days of exposure, especially to those under 5, and when attenuation is required it is better to give one half the standard dose as set forth within six days, than the full dose after that time. In securing complete protection with adult serum a flat dose of 10 cubic centimetres is as effective as an age adjusted dose. It was found that better protection rates were obtained among diphtheria than among scarlet fever and whooping cough patients, and also that more favourable results occurred in the second quarter of the epidemic (March to May) than in the first (December to February). Ten elaborate tables at the end of this paper give full details of the work, which should be in the hands of all with an interest in infectious disease. A. Joe.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 10.

J. Mental Sci. 1936, v. 82, 263-66, 1 fig. **The Value of Cholecystectomy in the Treatment of Enteric Carriers in Mental Hospitals. Report by the Infectious Diseases Sub-Committee of the Research and Clinical Committee of the Royal Medico-Psychological Association** [Golla, F., Chairman].

The conclusions and recommendations of a Research and Clinical Sub-Committee of the Royal Medico-Psychological Association are as follows:—

"(1) Successful results followed operation in 77 per cent of cases. Death followed operation in 21 per cent. Survival, but with continuance of infectivity, occurred in 2 per cent.

"(2) Age in itself did not appear to be related to mortality.

"(3) The presence or absence of depraved habits does not appear to be of marked importance.

"(4) After operation excretion of bacilli usually ceases within three weeks, but may continue up to about one year.

"(5) Several other factors were examined without providing any clue for the improvement of method."

After considering all the evidence, it appears to the Committee that the following recommendations can be made as reasonable and well founded:—

"(1) Cholecystectomy appears to be the only treatment which has any reasonable chance of success with fæcal excretors of the typhoid group of organisms.

"(2) Before operation it should be made certain that the patient is not a urinary carrier, since in these cases cholecystectomy is useless.

"(3) The case should be tested bacteriologically for not less than one year before operation, in order to make sure that the patient is really a chronic carrier and not a typhoid convalescent with a rather protracted period of infectivity.

"(4) As long as the patient appears reasonably fit, age alone is not a contra-indication to operation.

"(5) With cholecystectomy one may expect about 75 per cent of cures.

"(6) The operative mortality appears to be about 20 per cent.

"(7) The chance of the operation failing to cure the carrier condition is small—about 2 to 5 per cent.

"(8) There is evidence that curing the carrier condition is beneficial to the health of the patient.

"(9) After operation cases should be tested bacteriologically at weekly intervals, or more often for at least one year, in order to make sure that they really are non-infective before being returned to the general wards." [See also *Bulletin of Hygiene*, 1933, v. 8, 446, 730; 1934, v. 9, 114.]

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 10.

NGUYEN-VAN-TUNG. Immunité syphilitique, superinfection, réinfection [**Syphilitic Immunity, Superinfection, Reinfection.**] *Bull. Soc. Méd.-Chirurg. Indochine.* 1936, v. 14, 169-83.

Ricord maintained that a man could not have a second attack of syphilis; this view has held the field for a century and the general public still believes it. No doubt it held good in the time of Ricord and Fournier when the disease was only treated with mercury and iodide of potassium. We know now that this dictum is no longer valid. Immunity in syphilis is very real but it may diminish and even disappear altogether, with the possibility of superinfection in the first case and reinfection in the second. Four cases of reinoculation are quoted in detail. The first is thought to have been a superinfection; the second describes a congenital syphilitic who acquired syphilis at the age of 17 years, no uncommon event in Indo-China; the third was a case of tertiary syphilis, so adequately treated that there was little doubt that he was cured, who was reinfected; and the fourth was also almost undoubtedly a case of reinfection.

Clinical observation shows that reinfection is possible in treated cases; absolute immunity does not exist and experimental evidence proves this. Syphilis is auto-inoculable during the incubation stage and also during the first ten days after the appearance of the chancre. During the secondary stage immunity is almost absolute but during the tertiary period it diminishes. Superinfection is the term used for a second infection when the subject is not cured of the first; reinfection when the first attack has been cured. Immunity in syphilis is determined by the presence of the active virus in the host and this is the fundamental character which distinguishes it from the immunity of diseases in general.

In syphilis immunity only appears a few days after the chancre about

the time that the blood reactions become positive, reaches its maximum during the secondary stage, diminishes during the tertiary and finally may disappear altogether. Further, it only holds against spirochætes coming from without, failing against those within, to which latter the host is sensitized. Proof of this is the fact of primary, secondary and tertiary manifestations separated by "silent" intervals in which the disease appears to "sleep."

What is the explanation of these apparently contradictory facts? According to Bouveyron, Widal and Gougerot, the syphilitic possesses a mixture of immunity and sensitiveness; when the latter exceeds the former clinical manifestations occur and superinfection is possible. Both disappear in time and reinfection may occur. T. E. OSMOND.

Reprinted from "Bulletin of Hygiene," Vol. 11, *No.* 10.

COLE, H. N., with LIDA J. USILTON, J. E. MOORE, P. A. O'LEARY, J. H. STOKES, U. J. WILE, T. PARRAN, Jr., and R. A. VONDERLEHR. **Co-operative Clinical Studies in the Treatment of Syphilis. Cardio-vascular Syphilis.** *Venereal Dis. Information.* 1936, v. 17, 91-118. [Refs. in footnotes.]

The authors of this study are directors of the syphilis clinics of the Western Reserve University, The Johns Hopkins University, the Mayo clinic, the University of Pennsylvania and the University of Michigan (called the Co-operative Clinical Group) with some members of the U.S. Public Health Service. They say "there is no syphilitic involvement of the human body which is probably more frequently overlooked than that of the cardio-vascular system." The cause is the silence of the disease in its earlier stages and "insufficient attention on the part of the physician to premonitory signs and symptoms." They examined the records relating to cardio-vascular disease in 10,614 syphilis cases dealt with in the five clinics mentioned, and in 6,253 cases of late or latent syphilis found clinical evidence of uncomplicated syphilitic aortitis in 4·9 per cent, saccular aneurysm in 1·2 per cent and myocarditis in 0·8 per cent. The report is well worth careful study as it contains a great amount of valuable information on cardio-vascular syphilis which cannot be summarized here. It emphasizes the great importance of thorough treatment in the early stages of syphilis because the evidence shows that this is a valuable preventive of cardio-vascular syphilis. It stresses also the great importance of keeping a sharp look-out for cardio-vascular syphilis, because the earlier it is detected and treatment commenced the better the outlook. The signs which are considered important in diagnosis of uncomplicated syphilitic aortitis are as follows:—

(1) Teleroentgenographic and fluoroscopic evidence of aortic dilatation.

(2) A tympanitic, bell-like, tambour accentuation of the aortic second sound.

(3) A history of circulatory embarrassment.

(4) Increased retromanubrial dullness.
(5) Progressive cardiac failure.
(6) Substernal pain.
(7) Paroxysmal dyspnœa.

Any three of these in a patient with a history of syphilis are considered sufficient to justify a diagnosis. The authors consider also that a systolic murmur in the aortic area and increased pulsation in the episternal notch are very frequent signs. Some of the authors' findings in the cases of uncomplicated aortitis were as follows: (1) The Wassermann reaction of blood was positive in 72 per cent of the cases and spinal fluid abnormalities were present in 49 per cent. (2) In patients adequately treated in the early stages not one developed a grave form of cardio-vascular disease in a period of three to twenty years. (3) Cardio-vascular syphilis was either definitely or probably the cause of death in 7·9 per cent of patients inadequately treated after detection of uncomplicated aortitis as compared with 2·4 per cent adequately treated. (4) The average duration of life for patients whose cardio-vascular syphilis had been treated with small doses of arsenicals was twenty months longer than in those treated with large doses. (5) It is well to start treatment of aortitis with a course of heavy metal. In the cases of aortic regurgitation: (*a*) 69 per cent of the cases had had no treatment prior to detection of the lesion; (*b*) 62 per cent of those so treated had spinal fluid abnormalities; (*c*) the average duration of life after detection of the lesion was increased from forty months to fifty-five months by adequate treatment; (*d*) symptomatic relief was found in 30 per cent of patients who had received less than thirteen arsenical injections with interim heavy metal after detection of the lesion and in 60 per cent of those who had received thirteen or more arsenical injections with heavy metal.

In the series of aneurysm cases 64 per cent had spinal fluid abnormalities and 31 per cent showed concomitant neurosyphilis, principally parenchymatous. Of all the patients with aneurysm 77 per cent had received no treatment prior to the detection of the aneurysm. L. W. Harrison.

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Kennaway, N. M., and Kennaway, E. L. **A Study of the Incidence of Cancer of the Lung and Larynx.** *J. Hygiene.* 1936, v. 36, 236-67, 5 graphs. [22 refs.]

Examination was made of the death certificates of cases of cancer of the lung (8,808) and of the larynx (9,472) occurring in males in England and Wales for the years 1921-32 inclusive. The number of deaths registered in each of sixty-three occupations is compared with the number that would be expected to have occurred in that occupation according to the death rates from cancer of the lung and cancer of the larynx amongst all males in England and Wales during the same years at ages 20 and upwards.

A group of open-air occupations (gardeners, farmers, agricultural

labourers, including shepherds, farm bailiffs and foremen) and men employed in coal mining, both show very low ratios of observed to expected deaths. A group of open-air occupations where there is exposure to the dust of roads has rather high ratios for both lung and larynx. Grooms and horsekeepers, who are exposed to various forms of dust arising from horses and fodder, have an almost normal liability to cancer of the lung and no very high incidence of cancer of the larynx. Carpenters also show low ratios. These instances suggest that exposure to dust *per se*, irrespective of its chemical nature, does not conduce to cancer of the lung. Examination of the occupations with a high risk of silicosis indicated that the factors which lead to this condition are not very active in producing cancer of the lung or larynx. The occupations of barmen and cellarmen show by far the highest figures of any occupational group for cancer of the larynx. Workers exposed to coal gas and tar and those engaged in the preparation and sale of tobacco tend to show a relatively high rate of cancer of the lung. Professional occupations as a whole show favourable figures for both sites. Between 1921 and 1934 cancer of the lung as a registered cause of death has increased from 361 to 2,095 cases per annum in men and from 186 to 680 in women, ratios of 1 : 5·8 and 1 : 3·6. With regard to the view that this increase is due to improvements in diagnosis it is of interest to note that the death-rate of medical men from cancer of the lung is not excessive, and with them the availability of the existing methods of detection is presumably at a maximum. If the increase is a real one and due to any external factor, one would expect to find differences in the rate of increase in classes of persons exposed to different environments. This investigation reveals no special occupations to which the increase in the total can be specially attributed; rural workers show an increase which is not much less than that in the general population. It is concluded that no evidence has been found that tarring of roads has affected the incidence of cancer of the lung, and that such data as are available suggest that coal tar in the atmosphere, whether derived from roads, domestic chimneys, or any other source, does not readily give rise to it.

Cotton-mule spinners show a very small liability to the condition although they inhale air sprayed with an oil which produces cancer of the skin.

A. BRADFORD HILL.

Reprinted from "Bulletin of Hygiene," Vol. 11, No. 10.

DAWSON, M. H., and TYSON, T. L. **The Relationship between Rheumatic Fever and Rheumatoid Arthritis.** *J. Lab. & Clin. Med.* 1936, v. 21, 575-85, 3 figs. [39 refs.]

These authors pay lip-service to the view generally held in Europe that rheumatoid arthritis and rheumatic fever are distinct clinical entities, and that it is important to distinguish between them. They point out, however, that in their experience these disease pictures frequently overlap and that they frequently find it impossible to separate them. It is pointed out that in the German-speaking and Scandinavian countries two groups of cases

are recognized under the name of primary and secondary chronic polyarthritis: the secondary type being a sequel of rheumatic fever, and so constituting a group of cases resembling the classical form of rheumatoid arthritis, but being ætiologically intermediate.

Dawson and Tyson offer certain evidence in support of this view, suggesting that both rheumatic fever and rheumatoid arthritis may be intimately related ætiologically but constitute different clinical manifestations of the same pathological process. They discuss the familial relationship between the two diseases, finding in their series that 14 per cent of rheumatoid arthritis showed evidence of cardiac involvement. Geographically they point out the absence of both diseases in tropical climates, and their concurrent appearance when the temperate zones are reached. The initiating factor in a majority of cases of rheumatic fever can be shown to be an infection of the upper respiratory tract; they state that in 20 per cent of their rheumatoid arthritic patients also that this was so.

The seasonal incidence for rheumatic fever in U.S.A. and Canada is at its peak in March, both for initial attacks and also for subsequent exacerbations; they show a chart based on sixty-eight cases of rheumatoid arthritis showing that in these cases the same seasonal incidence could be shown. They discuss at some length also the question of the age incidence of the two diseases and the clinical manifestations at the various age periods. They point out that in the case of the rheumatic fever, 90 per cent of first attacks occur below the age of 15, whilst the reverse is true of rheumatoid arthritis. They found a 7 per cent incidence of heart disease in the latter series.

It is with regard to the pathological similarities that they find in the subcutaneous nodules from the two diseases, however, that they are most emphatic. They state that they bear every evidence of differing only in degree and not in kind. [They do not state, however, in what proportion of cases of rheumatoid arthritis these nodules are found; nor do they mention any study of the synovial tissues in the two types of case.]

They state that a large body of circumstantial evidence exists which implicates the *Streptococcus hæmolyticus* as a causal agent in both diseases and they give a brief summary of this recent work showing that in a very large proportion of cases of both rheumatic fever and of rheumatoid arthritis the antistreptolysin titre of the serum was significantly raised during activity of the disease. They state, moreover, that the sera of rheumatoid arthritics will agglutinate the *Streptoccocus hæmolyticus* in high titres and that precipitins for fractions of hæmolytic streptococci are present in these sera.

It is, they state, difficult to evaluate the exact significance of the immunological findings, but taken with the other general evidence which is presented, they are of the opinion that the two diseases may represent different responses to infection by the same agent. W. S. C. COPEMAN.

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Reviews.

TREATMENT OF FRACTURES IN GENERAL PRACTICE. By W. H. Ogilvie, M.D., M.Ch., F.R.C.S. London: John Bale, Sons and Danielsson, Ltd. 1936. Vol. i, pp. viii + 108; vol. ii, pp. vi + 72. Price 2s. 6d. per vol.

This is the second edition of these two little volumes which appear in the series of Pocket Monographs of Practical Medicine. The whole subject is dealt with in 180 small pages. The first volume deals with General Principles and Fractures of the Upper Limb and Limb Girdle. In the general principles there are brief but excellent descriptions of the pathology of bone, varieties and causes of fractures, symptoms, signs, and methods of repair, and the general principles of treatment of simple and compound fractures. The second volume treats of Fractures of the Lower Limb and Limb Girdle, and Fractures of the Spine and Thorax. Naturally in so small a space different methods of treatment cannot be discussed, but the author has given an extremely simple and concise description of his own methods, which are based on the most modern methods, the teaching of Bohler being followed to a considerable extent. A number of very useful diagrams are given which are clear and easy to understand. With few exceptions, the apparatus used is such as can be obtained in any small hospital, and the methods employed such as may be followed by any practitioner not specially skilled in the treatment of bone injuries. G. T. G.

CYSTOSCOPY AND UROGRAPHY. By J. B. Macalpine, F.R.C.S.Eng. Bristol: John Wright and Sons, Ltd. 1936. Pp. xiii + 478. Price 30s. net.

The appearance of the second edition of Mr. Macalpine's book is bound to be popular. The reviewer—a possessor of the first edition, published nine years ago—regards this beautifully illustrated book as one of the best on the subject published in England. New chapters have been added on Pelvic Resorption, Excretion Urography, and Pyeloscopy, and the illustrations have been increased.

The book will naturally make its greatest appeal to the surgeon or those officers in the Corps with surgical tendencies. It would be difficult to recommend a better book.

All operating room attendants, trained or under training, should know Chapter II (The Cystoscope—Mechanics, Optics, and Care of the Instrument) thoroughly.

John Wright and Sons' publication should be in every Military Hospital Library. D. C. M.

"PEEPS" ON THE NURSING TRAIL. By Derry Down. London: John Bale, Sons and Danielsson, Ltd. 1936. Pp. 174. Price 3s. 6d. net.

This cheerful little book should prove of considerable value to those contemplating nursing as a career—much good advice is to be found throughout the book and the writer's view that "nursing is still a vocation, not merely something to do," is worthy of very earnest consideration from intending candidates. The time-tables for a probationer on day and night duty give a good idea of the physical and mental demands which must be met while under training, and the excellent remarks on private nursing should be of real help when training is completed. Sympathy and cheerfulness—those two essential qualities in a good nurse—colour the whole book and give an added value to the sound practical advice which it contains.

THE AUSTRALIAN VICTORIES IN FRANCE IN 1918. By General Sir John Monash, G.C.M.G., K.C.B., V.D., D.C.L., LL.D. Published by The Australian Book Company, London. Sydney: Angus & Robertson, Ltd. 1936. Pp. xxv + 271. Price 6s.

The Australian Book Company have brought out a popular cheap edition of General Sir John Monash's well-known book, "The Australian Victories in France." In his preface the author says that he has made somewhat large claims on behalf of his Corps, but anyone who follows the story as detailed in these pages will surely say that these claims are fully justified. The great attack of August 8 is most vividly described. We think there is a mistake on page 52. July 15 is the date given there for the great German attack on the Chemin-des-Dames, whereas it should be May 27. There are one or two printer's errors—on the title page L.L.D. wants altering, and at the bottom of page 87 a line has crept in twice and spoils the sense. The book is a handy, well-printed volume and should reach a wide public. A. C. H. G.

REPORTS ON CHRONIC RHEUMATIC DISEASES: BEING THE ANNUAL REPORT OF THE BRITISH COMMITTEE ON CHRONIC RHEUMATIC DISEASES, APPOINTED BY THE ROYAL COLLEGE OF PHYSICIANS. No. 2. Edited by C. W. Buckley, M.D., F.R.C.P. London: H. K. Lewis and Co., Ltd. Pp. x + 140. Price 10s. 6d. net.

The second volume of the report of the British Committee on Chronic Rheumatic Diseases opens with an article by Professor Stanley Davidson and Dr. William Goldie on chronic infective arthritis. They deal with the subject in two parts; in Part I there is a discussion of the classification and interrelationship of the "rheumatic" disease; Part II deals with the ætiology of "Chronic Infective Arthritis" with particular reference to the part played by infection and diathesis in its production. The authors

consider that there is much in common in the ætiology of acute rheumatism and the more chronic types comprised under the title of chronic arthritis and that there is much evidence in favour of the hypothesis that infective arthritis is due to bacterial infection and sensitization. 70 per cent of these cases give a history of poor capillary circulation preceding the onset of arthritis as contrasted with 24 per cent of normal individuals of similar age.

The influence of tuberculosis in the ætiology of chronic rheumatism has been investigated by Dr. W. S. C. Copeman. He is of the opinion that there is considerable evidence in favour of the view that certain cases of polyarthritis masquerading as unrecognized "rheumatoid arthritis" of unknown cause are in reality tuberculous arthritis.

Dr. G. J. Griffiths furnishes the results of his studies on the bacteriological side of the disease. He considers that valuable information regarding the activity of the primary focus and quiescence or otherwise of the rheumatic condition can be obtained from a study of the streptococcal anti-hæmolysin titre of the serum and the intradermal tests in cases of rheumatic arthritis.

A valuable report on recent American work upon the rheumatic diseases is given by Dr. Philip Hench of the Mayo Clinic, Secretary of the American Committee for the Control of Rheumatism. He furnishes information and references to work of great importance carried out in the United States.

Mr. A. G. Tinsbrell Fisher emphasizes the importance of the close co-operation of the physician and the orthopædic department in the treatment of rheumatic types of arthritis, so that deformity may be prevented, or suitable corrective treatment instituted, at an early date, when required. He favours the method of correction by hinged splints rather than plaster casts ; this facilitates the alteration of the angle as improvement occurs.

A summary of the result of investigations into the metabolism of joint tissue is given by Dr. E. G. L. Bywaters, working under Professor E. C. Dodds, and from this study it would appear that one of the keys to the pathology of joint disease is the permeability of articular cartilage and synovial membrane.

This report presents accounts of clinical and laboratory observations and research which should be studied by all those interested in chronic rheumatic disease.

A. G. B.

Notices.

LONDON MEDICAL EXHIBITION.

New Hall, Royal Horticultural Society, Westminster, S.W.1.
October 19 to 23, 1936.

The scientific resources of Burroughs Wellcome and Co., and the continuous research work carried out by them, were evidenced by their preparations of "Stypven" Russell Viper Venom, described as the most efficient hæmostatic available; "Ryzamin-B," which consists of the concentrated and purified vitamin-containing fraction of rice polishings, having a potency of not less than fifty International Units of vitamin B_1 per gramme; and "Eulykol" phenylethyl esters of a selected fraction of the acids of hydnocarpus oil, introduced for the treatment of lupus vulgaris.

The section devoted to insulin included a display illustrating stages in the manufacture of "Wellcome" Insulin, which is made with crystalline insulin of 100 per cent purity. Ergot preparations occupied a prominent place, and were represented by ergometrine, the recently discovered water-soluble alkaloid and ergotoxine ethanesulphonate.

The work accomplished by the firm in connexion with digitalis was exemplified by digoxin, a pure, stable, crystallized glucoside isolated from the leaves of *Digitalis lanata*. Preparations of *Digitalis purpurea* included "diginutin," a stable solution of the total glucosides of the leaf (physiologically standardized); "Tabloid" digitalis leaf; and "Wellcome" tincture of digitalis.

In addition to vitamin concentrates, such as "Ryzamin-B," "Tabloid" carotene, "Tabloid" ascorbic acid and "Tabloid" calciferol, prominence was given to "Kepler" cod-liver oil with malt extract, which continues to meet the modern demand for a natural vitamin-containing product. A wide range of serological products was exhibited. These are prepared at the Wellcome Physiological Research Laboratories, Beckenham, Kent.

ACIGEN.

This drug, prepared by May and Baker, is a combination of mandelic acid, sodium bicarbonate, ammonium biphosphate and flavouring agents, presented in the form of granules.

It is intended for oral administration in the treatment of urinary infection.

Acigen serves to maintain the acidity of the urine, and does away in

most cases with the necessity for supplementary administration of ammonium chloride. Mandelic acid is excreted unchanged in the urine, and in order to ensure its sufficient concentration, the fluid intake should be restricted to not more than two pints a day. The acidity of the urine should be tested repeatedly throughout the course of treatment.

Two teaspoonfuls (3 grammes mandelic acid) should be taken in a small quantity of water four times a day immediately after meals. Treatment should be continued in most cases for ten to fourteen days. In cases showing resistance or relapse, treatment may be resumed after an interval of ten days.

CALCIUM GLUCONATE AND IRON.

FOR use in conditions which arise from a deficiency of calcium and iron, "Tabloid" Calcium Gluconate and Iron (Effervescent) has been issued by Burroughs Wellcome and Co., Snow Hill Buildings, London, E.C.1. One dissolved in a tumblerful of water makes an effervescent draught containing 20 grains of calcium gluconate and 3 grains of iron and ammonium citrate.

The product meets the physiological demand for calcium and iron in adults and children where a deficiency in the dietary supply is suspected, but where no actual clinical manifestations have been observed. Another suggested use of "Tabloid" Calcium Gluconate and Iron (Effervescent) is during pregnancy and lactation to reinforce the dietary calcium and iron in order to cope with the demands for these elements by the developing fœtus or infant. It can be given with advantage over a long period to ensure an adequate supply of calcium for fœtal bone formation, and to replace the abnormal loss of iron during the pregnancy.

The dosage of "Tabloid" Calcium Gluconate and Iron (Effervescent) in pre-natal cases is one product twice daily for a month, then after the lapse of another month the treatment is resumed. An alternative method is to give one product daily over a period of several months. Where there is a marked deficiency of lime in the water of some districts, larger doses can be given with benefit.

The dose for normal use is one or two products daily in a tumblerful of water.

INDEX TO VOLUME LXVII.

C.N. = Clinical and other Notes.
C.L. = Current Literature.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

Correspondence on matters of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a nom-de-plume.

All Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

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Communications in regard to editorial business should be addressed—"The Editor, Journal of the Royal Army Medical Corps, War Office, Whitehall, London, S.W. 1."

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The Annual Subscription for the Journal of the Royal Army Medical Corps is £1 payable in advance. Single copies, 2s. 6d. per copy.

Cheques, etc., should be made payable to the "Journal R.A.M.C.," and crossed "Holt & Co."

Each subscriber who pays his subscription direct to the Manager will also receive monthly a copy of "The R A.M.C., The A.D. Corps, and Q.A.I.M.N.S. *News and Gazette*."

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